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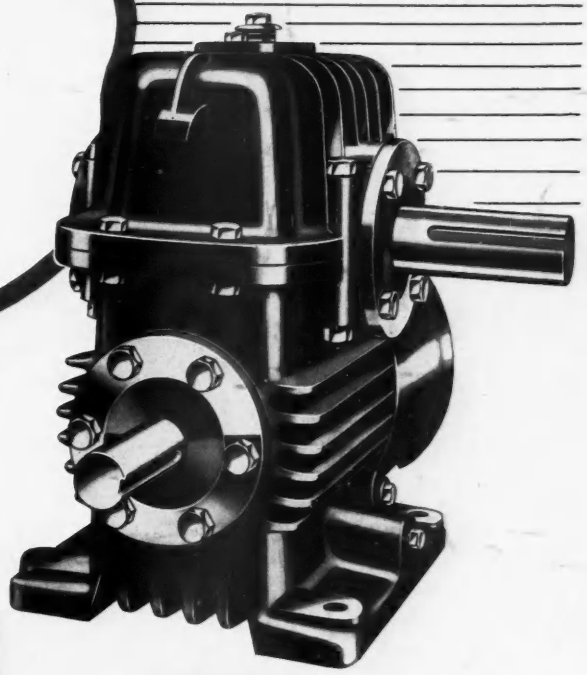

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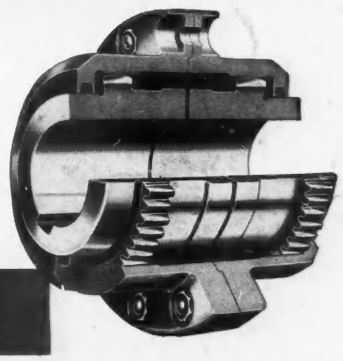

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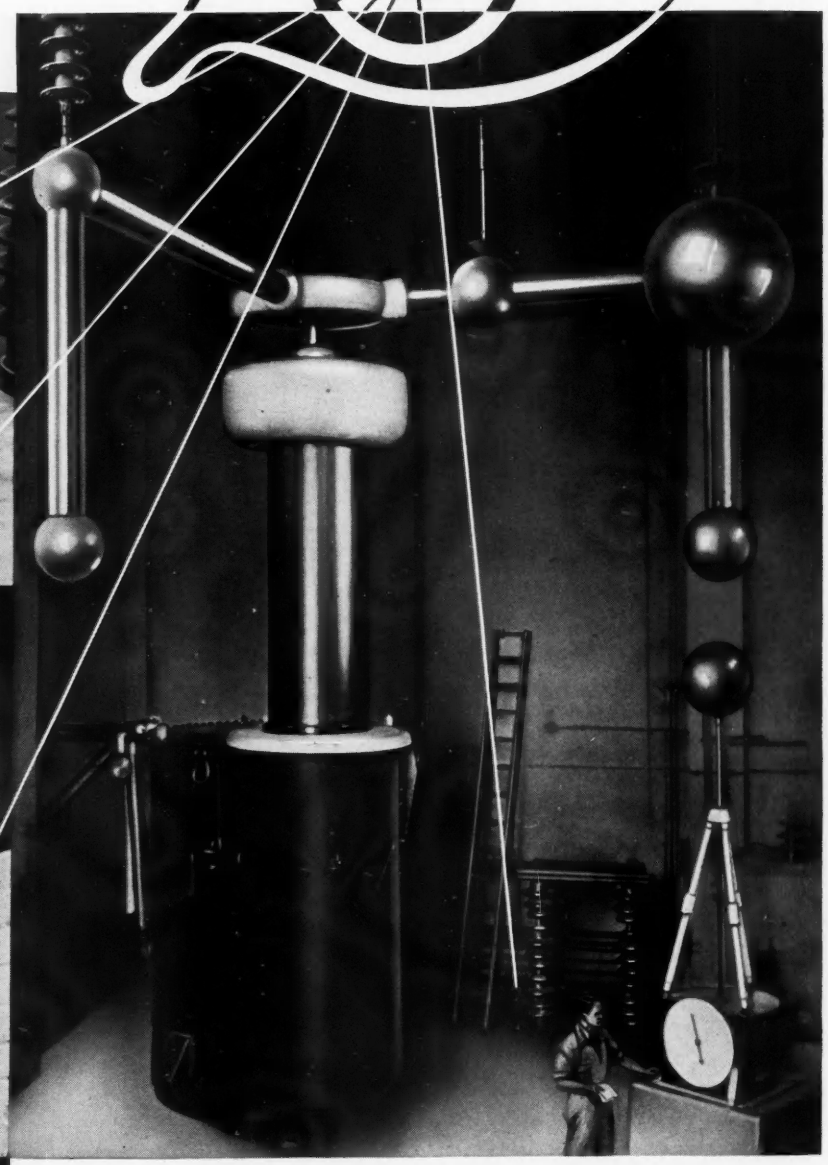

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A Seven-Day Journal

The Salvage of H.M.S. "Thetis"

FURTHER success has attended the efforts of the Liverpool and Glasgow Salvage Association to recover the sunken submarine H.M.S. "Thetis," and on Sunday evening, September 3rd, it was officially announced by the Association that lifting operations had been successfully terminated, and it only remained to drain the ship and to prepare her for towing to dry dock. As reported in last week's Journal note, on Tuesday morning, August 29th, the "Thetis" was in water shallower by some 56ft. than the water in which she originally lay in Liverpool Bay. On Wednesday, August 30th, two further lifts were made, and the sunken submarine had been brought to a point on the Anglesey coast about 3½ miles east by south of Point Lynas. The remaining lifts were shorter as the sea bottom shelved more steeply towards the shore. On Thursday a further move inshore was made with the night tide, and the submarine was then brought to a position about two miles off Moelfre, near Anglesey. Before the ship was brought further in towards the shore it was necessary to remove the periscopes, in order to avoid contact with the hull of the lifting vessel "Zelo." On Friday, diving work was prevented by a wind blowing from the north-east, which gave rise to unfavourable sea conditions. The general conditions, however, improved later, and the "Thetis" was finally brought on Sunday to a position off Traegh Bach Beach Anglesey, in about 37ft of water at low tide. Even at the lowest water the hull of the ship was lying about 2ft. below the surface of the water. As yet no official indication has been given with regard to the dock to which it is proposed to take the submarine for the removal of the bodies of the 99 officers and men, and the examination of the hull and machinery.

Materials Controllers Appointed

MR. LESLIE BURGIN, the Minister of Supply, has appointed the following persons to act as controllers of the important industrial materials mentioned herewith :—Iron and steel, Sir Andrew Duncan ; non-ferrous metals, including lead, zinc, tin, and copper, Captain O. Lyttleton ; aluminium, the Hon. G. Cunliffe ; wool, Sir Harry B. Shackleton ; flax, Sir Harry Lindsay ; hemp, Mr. A. M. Lindauer ; jute, Mr. G. Malcolm ; silk and rayon, Mr. E. W. Goodale ; leather, Dr. E. C. Snow ; timber, Major A. I. Harris ; paper, Mr. A. Ralph Reed ; sulphuric acid, Mr. N. Garrod Thomas ; sulphate of ammonia, Mr. F. C. O. Speyer ; other fertilisers, Mr. Howard Cunningham ; alcohol, molasses, and solvents, Mr. A. V. Board. For these materials it is essential that immediate action should be taken under the Defence of the Realm Regulations. Arrangements have, however, been made to secure that the trades and industries concerned shall be promptly notified of the scope of the initial control, and of the procedure which they should adopt. In the meantime the Minister of Supply announces that he would be grateful if traders would cooperate in seeing that the telephone and other essential means of communication are not congested by additional inquiries in connection with these matters. The degree and method of control for each of the above-mentioned materials will of necessity vary with the varying circumstances and trade practice, but the main objects of the control are the regulation of prices and the distribution of supplies equitably throughout the trades, preference being given to meet the Government's and the essential civil requirements. In the case of many raw materials which are also of importance in the present circumstances, it has been possible, we learn, by voluntary arrangements made with the traders concerned, to ensure the same results.

Labour Dilution in the Engineering Trades

IN one of our Journal notes of last week we made reference to the decision of the National Committee of the Amalgamated Engineering Union, with regard to the dilution of labour in the engineering industry during a condition of emergency. On Friday, September 1st, it was made known that an important agreement, on the increase of labour in the engineering industry, had been reached by the Engineering and Allied Employers' National Federation and the Amalgamated Engineering Union. The agreement arrived at was negotiated for peace-time emergency conditions, and it is fully expected that under conditions of war, even greater demands will have to be made on the labour power of the country. The agreement states that the rapid expansion of armaments production has put a strain on the industry, and the addition of large new factories may cause a further situation to develop, which might prejudice full production. In order to provide for this contingency and to supplement the skilled man-power where it can be shown that skilled men are not available and production is prejudiced, it has been agreed that an alternative class of worker may be employed on jobs hitherto done by skilled members of the union under reservations mutually accepted. It is further provided that such changes may be made if they are approved by a joint committee of the local employers and the union. A national joint committee will have the situation constantly under review. Any change under this agreement is to be registered, and such registers will be kept by the respective parties. When the situation no longer calls for the special measures, a return is to be made to pre-agreement conditions. It is felt by the union that the agreement is a satisfactory one, inasmuch as the rates of wages and the conditions in the industry are protected, as is also the restoration of pre-agreement conditions when the position is again normal. The scheme, it is felt, also precludes the undercutting of skilled labour by semi-skilled men.

A Printing Trade Agreement

ON Friday, September 1st, it was officially announced that an agreement which covers the emergency conditions in the printing and newspaper trades had been reached. An informal conference between representatives of the British Federation of Master Printers, the Newspaper Society, and the Printing and Kindred Trades Federation took place at which it was decided that any difficulties which may arise during an emergency will be met by both employers and employees, in a spirit of accommodation, a special emergency committee being set up to deal with them. The agreement reached came into operation at the beginning of September and it will be reviewed again at the end of the month.

Aircraft Exports Suspended

AT the end of last week the Board of Trade issued an Order replacing that which was recently made with regard to the export of aircraft and aero-engines, and suspending the operation of the Open General Export Licence No. G.L.168, which permits the export of civil aircraft and aircraft engines from the United Kingdom to any destination. The effect of the new Order is that until further notice no aircraft engines and no aircraft registered in the United Kingdom, except aircraft which are covered by special dispensations from the Air Ministry, and aircraft clearing from approved Customs aerodromes, either on air-line services or specially authorised flights, shall be shipped or flown from the United Kingdom to any overseas destination without a specific export licence granted by the Board of Trade. Such a licence, it is further announced, will not normally be granted except on the recommendation of the Air Ministry. All applications in connection with this matter should be addressed in the first instance to the Under-Secretary of State for Air, Air Ministry (Section S.S. (b), Berkeley Square House, London, W.1.

The Rationing of Fuel Supplies

IT is announced by the Secretary of Mines that there are considerable stocks of petrol in the country, but in the National interests the best use must be made of these supplies. For this purpose the petrol distributors throughout the country have arranged to pool all their resources, and after the individual brands still in stock at garages and service stations have been sold by them at the prices now ruling, one grade only of motor spirit is to be supplied to the public. The new spirit will be called pool motor spirit, and will be on sale in England and Wales at 1*s.* 6*d.* per gallon. It is announced that no change in the price will be made for the next fourteen days at least, and that existing differentials with regard to packing and special areas are to be maintained. It is asked that owners and drivers of commercial vehicles will take note that it will be no longer possible to allow commercial vehicles to call at petrol companies' depots for supplies. Rationing is to be introduced as from September 16th and ration books are to be issued. The Government makes an appeal to all owners of motor vehicles to use them only for essential purposes. Various Orders governing coal prices and distribution have been made by the Minister of Mines. Under the Fuel and Lighting Order, 1939, in order to conserve supplies and to provide against shortages due to local dislocations the quarterly consumption of coal, gas, and electricity by domestic consumers, and small industrial consumers, will be limited to 75 per cent. of the quantity consumed in the corresponding quarter of the year ended June 30th, 1939. The percentage referred to may only be varied by the Secretary of Mines. The Order is to be administered by local fuel overseers and by local advisory committees of supplying interests. The Order provides for the consideration of special cases by the local fuel overseer. No consumer of coal will be rationed below two tons per annum, and small consumers of less than two tons per annum will not be required to register ; but must obtain from the local fuel overseer a certificate which they must produce when they purchase coal. The rationing percentage of 75 per cent. will also be applied to the consumption of gas and electricity, but consumers will not be rationed below 100 therms of gas and 200 units of electricity in a year, and consumers who, in the year ended June 30, 1939, consumed less than those quantities will be entitled to consume up to those limits.

Loss of the Liner "Athenia"

SPEAKING in the House of Commons on Monday afternoon Mr. Winston Churchill, the First Lord of the Admiralty, stated that he regretted to inform the House that a signal was received in the Admiralty at about 11 p.m. on Sunday night giving information that the liner "Athenia," of the Donaldson Atlantic Line, Ltd., Glasgow, had been torpedoed in a position about 200 miles north-west of Ireland at 8.59 p.m. Orders had already been given by local commanders for destroyers to proceed to her assistance. At about 1 p.m. on Monday morning the Master of the "Athenia" sent a further signal stating that there were 1400 passengers, some of whom were still on board, and that the ship was sinking fast. The "Athenia," we may recall, is a ship of 13,465 gross tons with a designed speed of 17 knots which was built by the Fairfield Shipbuilding & Engineering Co., Ltd., of Govan, Glasgow, and is equipped with steam machinery and oil-fired boilers. She left Liverpool on Saturday afternoon, September 2nd, bound for Montreal. She had been ordered to steer a course well off her normal track, and would at the time presumably have been steaming at about 15 knots. Of the 1,400 passengers about 300 were United States citizens. A later message to the Admiralty from the captain of the ship stated that the passengers and crew, except those killed by the explosion, had taken to the boats and had been picked up by various ships. These included the Norwegian steamer "Knute Nelson," and the "Southern Cross," a private yacht owned by Mr. Wenner-Gren, of Sweden. On Tuesday, September 5th, some of the passengers were landed in Glasgow. In a reply given in the House of Lords on Tuesday, Lord Stanhope stated definitely that no British mines were laid in that part of the sea which it is desired to keep open as a trade route and which, in any case, is too deep for moored mines. Lord Stanhope accepted the evidence of a reliable witness that the submarine broke surface after firing the torpedo and was seen from the ship.

State Control of Railways

ON Friday, September 1st, it was announced by the Minister of Transport that he had made an Order, taking control of the undertakings or portions of undertakings in Great Britain wholly owned by, leased to, or operated by any one or more of the following railway undertakings :—the Southern Railway Company ; Great Western Railway Company ; London, Midland and Scottish Railway Company ; London and North Eastern Railway Company ; London Passenger Transport Board, and any joint committee of any two or more of the undertakings above named ; East Kent Light Railway Company ; Kent and East Sussex Light Railway Company ; King's Lynn Docks and Railway Company ; Mersey Railway Company ; and the Shropshire and Montgomeryshire Light Railway Company. It is further announced that the Minister of Transport has appointed to be his agents for the purpose of giving directions under the Order made, a Railway Executive Committee consisting of the following gentlemen :—Sir Ralph Wedgwood, who will act as chairman, Sir James Milne, Mr. C. H. Newton, Mr. Frank Pick, Mr. Gilbert Szlumper, and Sir William Wood. In order to meet the heavy demands for railway wagons during the present time of emergency, the Minister of Transport has requisitioned all privately-owned railway wagons, with certain exceptions, such as tank wagons, special wagons, and wagons not suitable for use on main lines. He has vested the Railway Executive Committee with power to use or deal with the wagons so requisitioned. In absence of any directions to the contrary by the Committee, the requisitioned wagons which are already upon or may hereafter be brought upon the system of any railway company whose undertaking is controlled by the Minister, will be used interchangeably with railway owned wagons in accordance with the directions of the Committee. Wagons standing on private sidings must be surrendered on demand by any such railway company, and such access to the private sidings as may be necessary for their removal must be afforded to the railway company. Until such demand is made, however, wagons may be loaded and despatched as usual. Wagon hire will hereafter be charged for the use of all requisitioned wagons for traffics the existing conveyance rate for which does not include wagon hire. Copies of the notice of requisition are obtainable from the Stationery Office and any booksellers.

A History of Rotary Engines and Pumps

PART II.—No. VII

(*Continued from page 229, September 1st*)

SCREW PUMPS

THE idea of using a screw to lift water is as old as Archimedes. But the original Archimedean screw pump was in effect a special form of the bucket machine. It could lift a liquid, but could generate no pressure. Forms of screw pumps and engines which would have a positive acting characteristic were suggested on many occasions in the nineteenth century, but not until recent years has any notable success been attained.

In this country screw pumps made in large sizes are now able to compete successfully in certain services with centrifugal and piston machines. They are made by Stothert and Pitt, Ltd., of Bath, under licence from Machinefabriek Houttuin of Holland. Two square-thread screws of opposite hand are arranged in a close-fitting case so that their threads intermesh. They are linked by external gears and driven in opposite directions at the same speed. Since the intermeshing of the threads forms a barrier or "abutment" through which liquid entrained between the threads cannot pass, the liquid is forced to pass along between the threads from the suction end to the discharge. In a simple arrangement such as that just described the whole discharge pressure would act upon the ends of the screws tending to push them axially out of the casing. It is therefore usual to place two screws on each of the shafts and arrange for the liquid to be drawn in at each end and discharged at the centre—Fig. 79—thus obtaining axial balance.

The design has the advantage that the screws can be so constructed and so adjusted relatively that there is no contact between them, whilst the diameter of the casing can be arranged to allow a fine clearance over the tops of the threads. In consequence the device has been found particularly suitable for pumping such non-lubricant fluids as water, petrol, Diesel oil, gas oil, chemical solutions, &c. It is less well suited to the pumping of fluids with higher viscosities because the fluid is required to move helically, relatively to each screw, along the thread, and, the path being a long one, fluid friction can become high. But this disadvantage is not so great as altogether to bar the use of the pump with such fluids. It has counterbalancing useful qualities. More particularly, it can operate under adverse conditions of suction lift that few other pumps could contend with. Hammer arising from cavitation, prevalent in many displacement and centrifugal pumps under vacuum, is claimed to be entirely absent, and experiment has demonstrated the ability of the machine to continue to operate quietly and to hold the discharge pressure even when large quantities of air are permitted to leak into the suction pipe. Frothy fluids, too, can be successfully lifted. The pump has, in addition, the ability to run at high speeds so that it can be directly connected to an electric motor. It is at present made by the firm in a range of sizes with capacities from 10 to 1650 gallons per minute and in a number of forms suitable for differing applications.

A typical commercial spirit pump is illustrated in Fig. 80 and the drawing, Fig. 79. The pump being intended for benzene is arranged to be driven by a 5½ H.P. motor through an isolating wall box. Had the purchasers not called for the isolating box, a flameproof motor would have been chosen. The pump is rated to deliver 137 gallons per minute of the spirit against a discharge head of 60ft. It draws from a depth of 15ft. and runs at 1440 r.p.m. The drawing shows the general details of the design. Shafts are carried in ball and roller bearings arranged outside the pump glands so as to avoid contamination by the spirit. A separate gear-box with an oil bath encloses the timing gears, which are hardened and ground. Fluid is drawn in at the ends of the screws and discharged from the middle. The glands are therefore on the suction side so that no leakage of the spirit along the shafts is likely to occur while the machine is running. To guard against leakage when the shafts are not turning a non-solvent grease is fed to a lantern ring in each stuffing-box from a grease cup. High-grade cast iron is the material used for the pump body and covers, and the shafts and screws are made from 40/45-ton steel. Renewable sleeves of the same material are fitted in way of the glands. A total working pressure of 75 lb. to 80 lb. per square inch is the highest for which pumps of this kind are made as standard, but if a higher pressure must be reached specially designed machines can be supplied. The performance of the pump is shown by curves reproduced in Fig. 81.

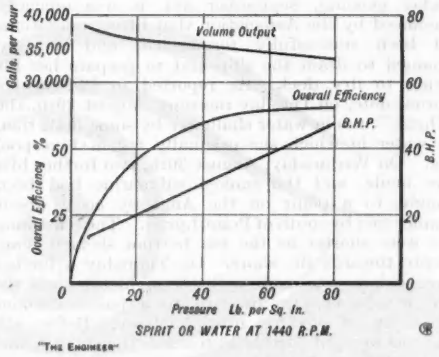


FIG. 81—PERFORMANCE OF SPIRIT PUMP—STOTHERT

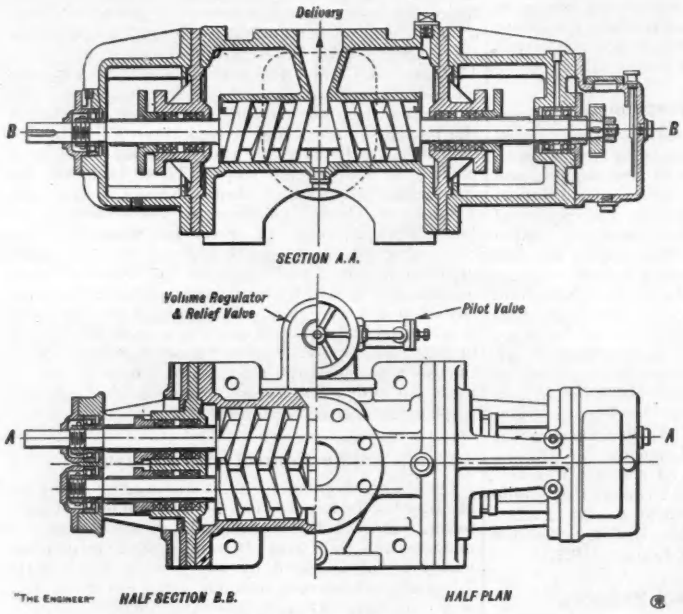


FIG. 79—ARRANGEMENT OF BENZINE PUMP—STOTHERT

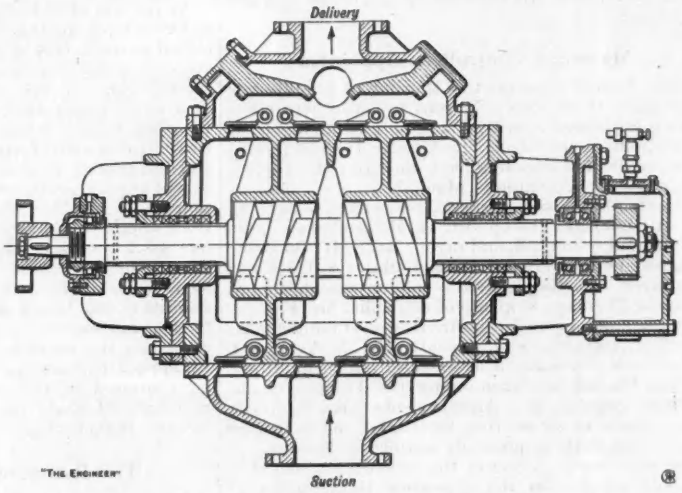


FIG. 82—UNIFLOW SCREW PUMP—STOTHERT

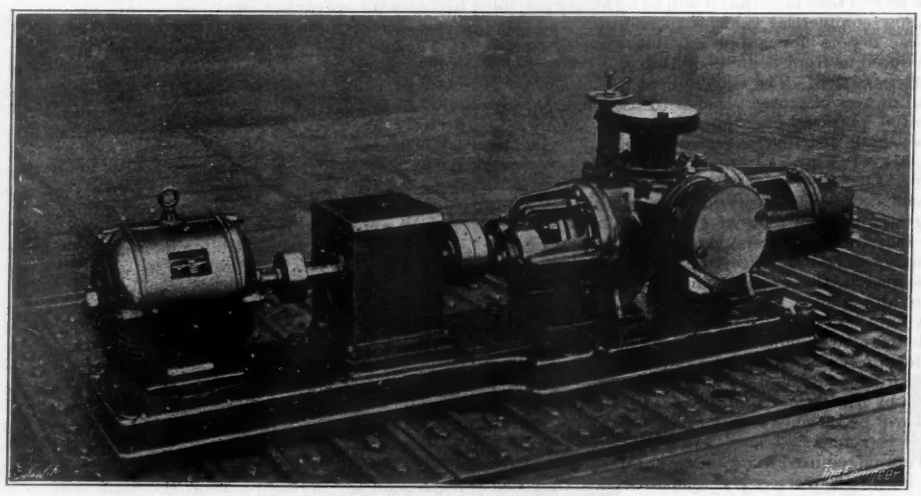


FIG. 80—BENZENE PUMP—STOTHERT

Though the main field for the use of the screw pump, and that for which Stothert and Pitt, Ltd., mainly adopted it, is undoubtedly the pumping of non-lubricant fluids, it has found other uses. A range of machines giving outputs between 40 and 350 tons per hour, and running at speeds between 1400 and 1000 r.p.m., has been standardised by the firm for marine lubricating oil service. The drawing reproduced in Fig. 83 shows the arrangement of one of these pumps. It is claimed that for outputs in excess of 150 tons per hour the machine is likely to be smaller and lighter even than a centrifugal pump for the same duty. As compared with the centrifugal the machine has the advantages that it is practically unaffected by air leakage into the suction pipe, and that its volumetric efficiency is practically constant over a wide range of viscosity and pressure at any given speed. This latter point is illuminated by a reference to the performance curves reproduced in Fig. 84. A typical pump to which the performance curves apply, has an output in normal service of 225 tons per hour when running at 1000 r.p.m. and delivering

against a pressure of 55 lb. per square inch. The 85 H.P. motor develops sufficient power at 1000 r.p.m. to maintain that output when the oil viscosity does not exceed 300–400 seconds Redwood No. 1. When starting from cold, however, the viscosity is likely to be in the neighbourhood of 2000 seconds Redwood No. 1, and to meet these conditions the motor, which is a D.C. machine suitable for marine service, is designed to develop its full power at 800 r.p.m.

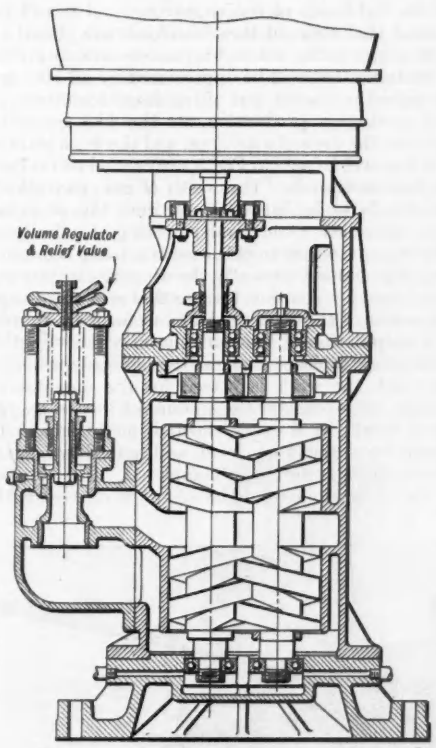


FIG. 83—LUBRICATING OIL PUMP—STOTHERT

Performance curves for both conditions are reproduced.

The design of pumps in this range varies from that of the spirit pump just described, not merely in that the screws are arranged in the vertical position, but also in the situation of the bearings. The latter, together with the gears also, are housed within the main body. They are fed with lubricant under pressure from the pump discharge. Owing to this arrangement, it is possible to design the pump with only a single gland. The shafts are

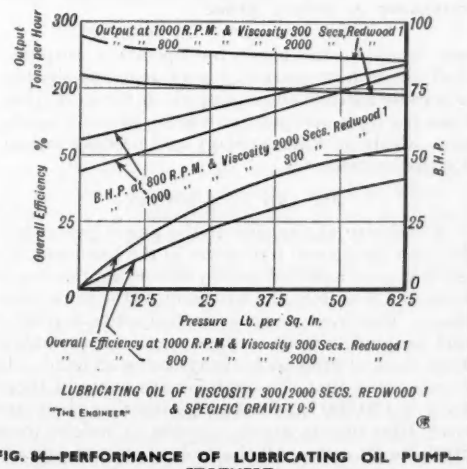

Output Tons per Hour
Overall Efficiency %
B.H.P.
Output at 1000 R.P.M. & Viscosity 300 Secs, Redwood 1
" " 800 " " " " 2000 " "
B.H.P. at 800 R.P.M. & Viscosity 2000 Secs. Redwood 1
" 1000 " " " 300 " "
Pressure Lb. per Sq. In.
Overall Efficiency at 1000 R.P.M & Viscosity 300 Secs. Redwood 1
" " 800 " " " 2000 " "
LUBRICATING OIL OF VISCOSITY 300/2000 SECS. REDWOOD 1
& SPECIFIC GRAVITY 0·9
"The Engineer"

FIG. 84—PERFORMANCE OF LUBRICATING OIL PUMP—STOTHERT

located at the top in two double-purpose ball bearings, and are left free in journal bearings at the bottom to expand as the oil warms up.

Screw pumps have been made by the firm for a number of other services, including oil loading and bunkering, a particularly arduous duty for which the pump must be capable of handling oils with a very wide range of viscosities. But we intend to terminate this account of the firm's products with a reference to the installation of screw and rotary displacement pumps illustrated in Fig. 85.

Normally in oil engine driven ships the engine auxiliaries are operated electrically from the separate generating set. Some years ago Stothert and Pitt, Ltd., developed a system in conjunction with the engine makers, by which they could be operated directly from the engine, and the system was first tried on a large scale by the Anglo-Saxon company. The system has the advantages of economising in electric generating capacity, of saving space, and of improving overall efficiency, and also results, it is claimed, in a saving of first cost. The auxiliaries concerned are the salt water circulating, piston cooling, bilge, sanitary, lubricating oil, and fuel oil service pumps. Owing to the variation of the main engine speed during manœuvring, centrifugal pumps cannot be used, and the

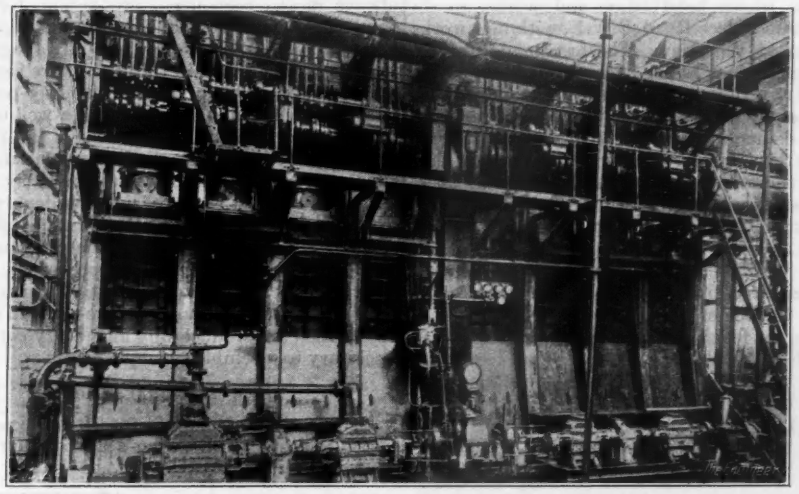


FIG. 85—MARINE OIL ENGINE AUXILIARIES ARRANGEMENT

displacement variety must be adopted. A chain drive is taken from the crankshaft about midway along the engine. Through clutches it drives a lay shaft on each side extending along the engine. In the particular installation illustrated, these shafts run at 275 r.p.m. One drives directly the bearing lubricating oil pump, a "Seven-Eight" rotary, and the other the fuel service pump, a "Three-Four" rotary. The shafts are also connected through speed increasing gears to the main shafts of four screw pumps, two to each lay shaft, running at 758 r.p.m. These pumps are the salt water circulating and piston cooling fresh water pumps on one side, and the bilge and sanitary

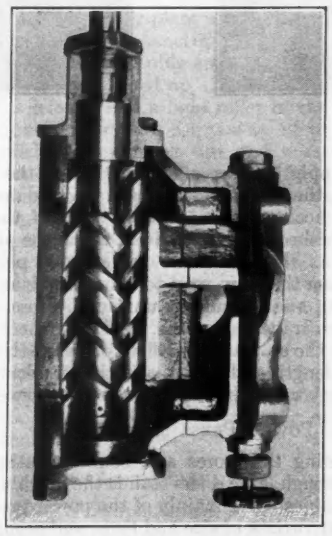


FIG. 86—"IMO" PUMP—MIRRLEES

pumps on the other. Particulars of the pumps are given in the following table :—

Duty.	Pump type.	R.p.m.	Pressure, lb. per sq. in.	Delivery, t.p.h.
Salt water circulating	Screw	758	21·5	230
Piston cooling (fresh water)	,,	758	43	69
Bilge	,,	758	30	32
Sanitary	,,	758	30	32
Lubricating oil	Rotary	275	30	40
Fuel oil service	,,	275	30	5

The salt water circulating, piston cooling, lubricating oil, and fuel oil service pumps are all required to deliver through the same branch, whether the main engine is running forward or reverse. A "uniflow" rotary displacement pump has already been described and illustrated in a previous section of this series. To effect the same object in the screw machine, a design such as that illustrated in Fig. 82 is adopted. Non-return valves arranged between the two sides of the pump ensure that in whichever direction the screws turn delivery will always take place through the discharge port.

Another screw pump under manufacture at the present time and only introduced during the last year or two is that made by Mirrlees, Bickerton and Day, Ltd., of Hazel Grove, near Stockport. This machine, which is illustrated in Fig. 86, is intended particularly for pumping against high pressures, and is made capable of delivering oils, grease, and similar liquids against pressures up to 2500 lb. per square inch. The principle is the same as that of the machines just described, but is applied differently. A central shaft with a thread of large pitch runs in mesh with and drives two screws of smaller diameter, one on each side. The casing is suitably shaped to fit closely around the screws. A diagram, reproduced in Fig. 87, shows the performance of a lubricating oil pump of this construction. It is claimed that efficiencies as high as

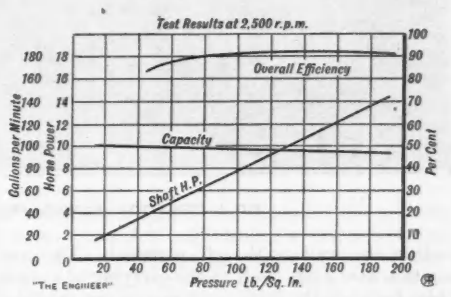


FIG. 87—PERFORMANCE OF "IMO" PUMP—MIRRLEES

90 per cent. can be attained on lubricating oil, as shown by the graph, and that even on fuel oil an efficiency of 80 per cent. can be reached.

(To be continued)

RHODESIA'S ELECTRICITY SUPPLY.—The demand for electricity in Southern Rhodesia has trebled in one year according to the report of the Electricity Supply Commission for the year ended March 31st, 1939, the third year of the Commission's existence. Sales increased from ten and a half million units sold for the year ended March 31st, 1938, to thirty million units for the year ended March 31st, 1939. At the close of 1939, the rate of supply had increased to forty million units per annum, and is now approaching fifty million per annum. Among the consumers there were five municipalities. Two of these, Bulawayo and Salisbury, figure in the report as suppliers of six and a half million units and two and three-quarter million units respectively. Many of Southern Rhodesia's mines are now taking current from the Commission with the result that destruction of the timber resources of the colony is being checked. Since the Electricity Supply Commission started operations just over three years ago, it has spent over £900,000 on capital account, of which £470,000 were expended on transmission lines, on which a further £84,000 will be spent. The whole power supplied by the Commission was produced by coal from the famous Wankie mine in the colony, the fuel being used at the rate of 50,000 tons per annum. Some 80,000 tons per annum will, however, be needed by the end of the current financial year. An interesting development of the electricity supply in Southern Rhodesia is the interconnection of three power stations at Gatooma, Queque, and Gwelo, forming the first link of a grid system in the colony.

Industries In and Around London

By JOHN HOLLOWAY

No. VI.—ART METAL CONSTRUCTION COMPANY

Steel Office Furniture and Warehouse Equipment

ONE of the first firms to make steel office furniture in London was the Art Metal Construction Company, whose head office and works are in Buckingham Palace Road, S.W.1., with new works extensions at Wembley. The firm made its first steel filing cabinet as far back as 1888, at a time when the advantages of using steel in place of wood for office equipment was hardly recognised, and the market demand was practically non-existent. Probably the only steel office equipment used at that time was the time-honoured cash box, and also, perhaps, those familar black-painted deed boxes seen stacked up in the offices of family solicitors.

Range of Manufacture

Another direction in which the firm is displacing wood by the use of steel, is in the construction of partitions for fencing off private compartments in offices where the floor area is large and undivided by walls, a feature that is now common in many big blocks of offices recently built in London and elsewhere. These steel partitions are not unsightly, and measures are taken to damp down noise by insulating the walls with soft material. The construction also lends itself to the carrying of electric cables between the walls, and means are provided for giving easy access to the cables when required.

So much progress has been made in the design and construction of steel furniture, that it is now possible to obtain practically every office and warehouse appointment in that metal. The firm is exclusively engaged in this business, and during its long experience has evolved many designs that not only meet the exacting requirements of the modern business office, but are pleasing to the eye and convenient in use.

Lay-out of Works

The headquarters of the company are in Buckingham Palace Road, and here are housed the office staff, and also the sales and service organisations. The works adjoin the office, and a new extension has lately been added to increase the floor space and accommodate more plant, this having become necessary to meet the demand for larger deliveries of finished goods. But there is usually a limit to which existing works can be extended, particularly in a London Area near to Victoria Station, and so to increase further manufacturing facilities, the firm has found it necessary, and probably desirable, to build new works and to equip them with a completely self-contained plant, and at the same time make provision for further extensions, on rational lines, whenever that becomes necessary. These new works have been planned and built in the modern style on an extensive site.

Dealing first with the older works in Buckingham Palace Road, the lay-out and arrangement of departments and plant here have been, very largely, dictated by the nature of the building, so that it has not been possible to follow strictly straight line production, as is now generally aimed at by the lay-out engineer, and as accomplished in the works at Wembley. But no one should make the error of assuming that straight line production by itself always means economical production, for it certainly does not. It is an important factor in the economics of the work-shop, but only a factor, and unless other elements in the scheme are right, may accomplish very little, though whenever possible it will be adopted in the lay-out of a well-balanced manufacturing plant. In the case of the Buckingham Palace Road works, distinctive manufacturing processes are carried out in separately housed departments, and the work in each department is arranged for in advance by the planning office staff which issues an information schedule or operation sheet to the department concerned. These schedules are the key to the routine which is to be followed in the works, and the size of metal required to be used to produce any and every component necessary to assemble a complete unit.

Raw Material Stores

In this class of manufacture it is necessary to carry large stocks of raw material to ensure a constant supply being available for use in the works, and here the store space has been planned on liberal lines to accommodate a heavy stock of the cold-rolled finished steel sheets from which the products are made. The stores are conveniently placed for entry from the main road to allow lorries and vans to run in, and be quickly unloaded by an electric overhead travelling crane. All the sheet metal entering the stores is classified for gauge thickness, and for length and width, and then packed flat in tiers ready to be issued on demand to the works.

Power Press Machine Shop

Adjoining the stores and communicating with them through large doors stands the machine shop, the machines being mainly of the power press type in a great variety of size and type, and occupying a large space in the building. Every machine is separately motor driven, and in all there are approximately 255 electric motors in use at these works, ranging from 1 H.P. to 30 H.P. the current being supplied from electric companies' mains. In this class of manufacture there is undoubtedly a distinct advantage in the individual electrical motor drive, as many of the machines are fitted up with dies and press tools to carry out and complete all the necessary operations on the sheet steel to make a finished component. Moreover the great difference in the size of machines and the position they occupy on the shop floor is sufficient to cancel out all the claims made for "group" driving. In work of this nature the individual motor drive makes it possible to use the floor space to greatest advantage, both as regards area occupied and convenience in handling material, and floor space alone, in a London works, is something worth considering if site values are appreciated.

In this power press machine shop the large machines are placed lengthwise with the building while some of the smaller machines stand at right angles for convenience and saving space. Included in the heavy class of machines is a 12ft. 300 ton shearing and forming press, and three 10ft. machines, all being available to deal with the longest sheets used. Fig. 1 gives a view of some of these machines engaged on normal work in the shop. Another section of the same shop is seen in Fig. 5, p. 258. A group of the smaller presses is to be seen on the right side of the engraving, and it will be noticed that some of these machines are placed at right angles to the others for reasons already given.

Features that will be appreciated by all who are interested in the lay-out of machines for intensive and continuous production, are the wide gangway between the rows of machines, and the work stands, which as will be seen in Fig. 5, are carried on runners for ease in transit. The width of gangway allows the stands to be backed away from the machine, then swivelled round and run away to the next department, which in this case is usually the welding shop, but is frequently the dipping and stoving department. Another feature that will not escape the notice of those on the look-out for ideas in case of manipulation of the work-piece, is the height of these work tables. Look at the convenient height at which the work is placed for the operator to handle, then consider the amount of wasted energy there would be if every sheet of metal had to be lifted from the floor level and put down again when the operation was completed. The moving of the metal alone would be a hard day's work without handling the sheet for operative purposes. And yet in how many engineers' machine shops—otherwise well run and equipped—is the work lifted from the floor and put down again at every operation, involving wasted energy and needless fatigue for the operator.

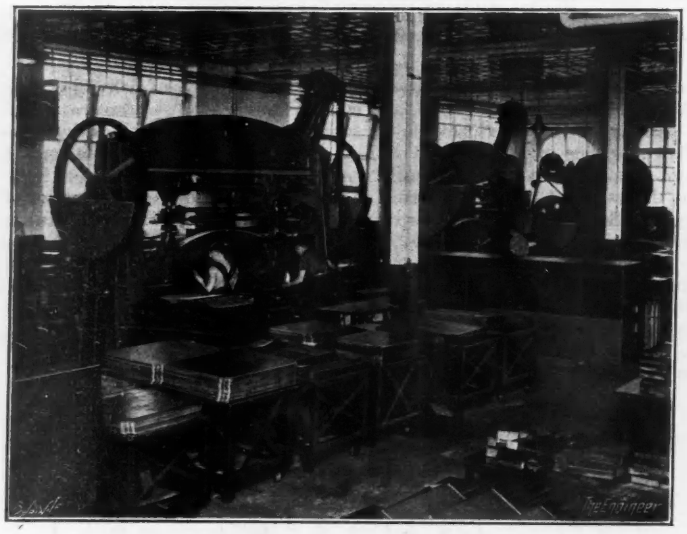


FIG. 1—TEN-FOOT POWER PRESSES

FIG. 2—CHARGING A DRYING STORE

Jig and Tool Stores

A stairway at the side of the power press shop leads to the jig and tool stores in the basement, an electric hoist installed nearby conveying the heavy tools and dies from the basement to the press shop floor. The great variety of steel office furniture and equipment made in these works necessitates a huge stock of press tools always being on hand. It is estimated that the approximate value of these tools is £50,000, and taken all together there are over 1000 dies in stock, varying in weight from 20 lb. to 30 cwt. All the tools, dies, and jigs are designed in the firm's own drawing office, but are made outside by specialists like Dormer and Wadsworth, of Rochester Row, for medium sizes. Rosser and Russell, of Hammersmith, for the large and heavy types, and John McClark, of Putney, for small sizes.

After the tools have been used on the presses for production work, they are sent to the tool room for examination, and for repair when necessary, before being returned to the stores; that is a routine order that is never allowed to lapse, as a damaged press tool may prove very costly in defective production.

When handling a big number of tools, and particularly press tools with their several and sometimes many distinctive parts, it is easy to see what confusion and trouble might arise unless a proper system of checking and indexing was enforced.

Hence the management has adopted a card index system which is rigidly enforced, and with this system the whereabouts, condition, and history of each tool can be quickly ascertained and checked. To facilitate this very necessary indexing system, each tool and part of a multiple tool is identified by a symbol, and when not in use the tools are stored in a bin bearing the symbol of the tool, and agreeing with the registration in the card index.

To accommodate and protect this fine equipment, on which so much time and money have preforce been spent, the stores are fitted out with partitioned shelving which extends round the walls and forms compartments or bins. Every compartment and its contents are visible and accessible, and the lables bearing the identification symbols can be seen and read at a glance.

Works Tool Room

As already stated, the press tools are made by London firms which have the equipment for this specialised work, and in consequence the tool room at the art metal work is only intended to make repairs and replacements of small parts as these become necessary to keep the tools in good working order, and to ensure the reproduction of stamped and pressed goods with accuracy and despatch. But though not large, the tool room is equipped

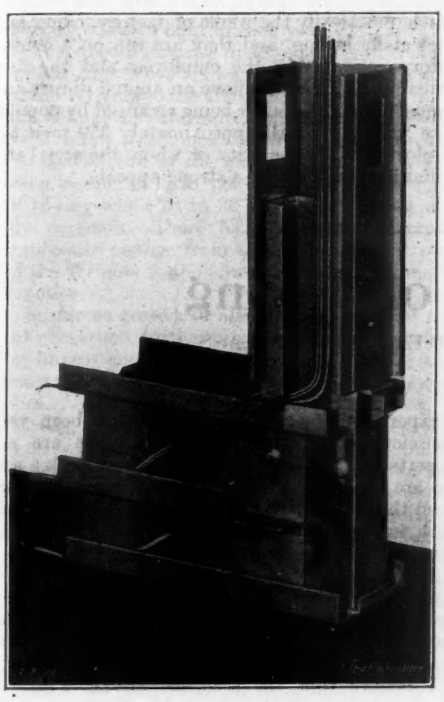


FIG. 3—METAL BASE AND POST

with modern machine tools of adequate capacity and range to cope with the work for which it is intended; there are, for instance, 8in. all geared head S.S. and S. lathes, a Pratt and Whitney wet-surface ginder having 42in. stroke and admitting 14in. in height between table and wheel, a Pollard Radial drill, a Jason Horizontal Miller, a Palas surface grinder, a couple of shapers and so on.

Welding Department

Welding is carried out in a separate shop, see Fig. 6, p. 258, there being about a dozen men solely occupied on this work. Many of the parts are assembled in specially constructed jigs to ensure perfect positioning before welding. The jig in which the pedestals for all steel desks are assembled is of special interest; it has been designed on substantial lines to prevent warping under local heat, and the inside is copper faced on location places for conductors. The sides and the front end are secured with quick-acting clamps which allow instant opening of the jig for withdrawing the pedestal after welding. With the use of this jig it is possible to assemble a complete pedestal—comprising the two side and back plates, and intermediate runners for the drawers—with perfect accuracy, and to spot weld at the location points, at a speed that is amazing. True it is an expensive jig to make and could only be justified where the production was large and practically continuous, but given these conditions, as is the case here, the jig though expensive is soon paid for by the accuracy of alignment in the assembled unit, obviating as it does any need for straightening or squaring up, and by the rate at which the dual operation of assembling and welding can be done.

After welding, all the parts are taken to a room close by to have the high welded spots smoothed off by grinding. The tools used for this process are portable electric grinding machines of light construction.

Dipping, Spraying, and Stoving Department

All the processes connected with finishing the surface of the metal parts are carried out in a separate department, which, in addition to the process plant proper, is fitted with fire precaution and fire extinguishing plant to meet the requirements of the L.C.C. Fire department, the entire fire-fighting apparatus having been installed by The Pyrene Co., Ltd., of Brentford. For the purpose of cleaning the metal surface and afterwards coating it with specially prepared paint, two large rectangular tanks have been sunk in the floor, one containing paraffin and the other paint, into which the parts are dipped, first in the paraffin for surface cleaning and afterwards in the paint; the paraffin is cleaned every week by pumping it through a metafilter, supplied by Metafiltration, Ltd., Hounslow. All the usual facilities are provided for leading the "drip" back again to the tanks. There is also a paint spraying plant, used for giving the finishing coat to the metal parts, and a drying and hardening stove. The temperature drying after dipping is 350 deg. Fah. and for drying and surface hardening after spraying 250 deg. Fah. These stoves are large and can accommodate a great number of parts simultaneously, each suspended from a specially constructed carriage which is supported from overhead trolleys and runway as shown in Fig. 2. The routine process of surface finishing is very similar to that followed in motor car works for finishing steel bodies: the surface of the metal is first cleaned by washing in the paraffin tank, it is then dipped in the paint tank and allowed to hang until all the superfluous paint has dropped off, then comes the first stoving and drying, followed when cold by sanding, or rubbing down with sand and water to give a smooth even surface, after which the finishing coat is sprayed on and the part is stoved again to dry and harden the surface quickly. But this process only applies to parts that are finished in self colour. Sometimes a grained surface is asked for by purchasers to match wooden furniture in an office. This work is done in a separate department and has been standardised as far as possible. A photographic or copying process graining apparatus has been installed which allows a steel plate up to 8ft. by 3ft. to have, say, a walnut wood grain perfectly transferred. Briefly, the apparatus for this process consists of a copper plate with the top surface engraved to resemble a panel of choice walnut; the plate lies flat and is suitably supported in a frame which is carefully levelled up. There is also a roll of printer's gelatine and a light roller in the outfit. To carry out the process, a quantity of prepared paint, mixed to the correct tint and viscosity, is spread evenly over the engraved surface of the plate, a squee-gee is then passed over it to remove all the paint from the high surface, and leave it lying only in the engraved lines representing the grain. The gelatine roll is then pressed on the surface to take the imprint of the paint, after which the roll is passed over the prepared steel plate to transfer the imprint to the surface of the steel. By this means a faithful reproduction of the engraved copper plate is obtained. In some instances, where a given grain is not required in large quantities, graining is done by hand with the ordinary graining tools and methods.

Assembling

Heavy stocks of components of all sorts are stored in readiness to be drawn on for assembling complete units, and the practice of storing parts in preference to assembled furniture or other equipments, results in saving much valuable space. Even so, the size of the stock carried necessitates large stores which are laid out with shelving and bins, all labled with particulars of each part, from which the assembling room is supplied.

A view of the interior of the assembling room is given in Fig. 7. It will be noticed that the work here is carried out on a large scale, batches of twenty-four desks going through together, and it will also be seen that many parts have been drawn from the stores and stand in readiness to be fitted together. This work is made comparatively easy and rapid by the accuracy of the welding operation, which in turn has been greatly simplified by the use of the special jigs and fixtures. Another advantage is the almost entire absence of bolts and nuts in the construction of art metal furniture, these being unnecessary as all fixed parts are welded together, while all movable parts are held in position by frictional pressure arranged for in the design.

New Works at Wembley

At Wembley the new works have been designed and laid out to secure the greatest advantage from advanced planning for the manufacture of certain specific items of steel office furniture and warehouse equipment, including filing cabinets, cupboards, shelving, and also partitions with posts and doors.

As might be expected the new building is in striking contrast to the old works, and while no particular attempt has been made to ornament the exterior, it is none the less pleasing to the eye. The firm has also wisely secured sufficient ground to allow for future extensions as these become necessary. All work is done on the ground level, and the floor area of the present factory is 62,000 square feet, and the ground available will allow this to be increased to 280,000 square feet with buildings of the same character as those now existing.

Special attention has been given to heating and ventilating the works throughout, the work for this having been carried out by W. H. Hutton and Co.,

FIG. 4—CONVEYORS AND RUNWAYS

Ltd., of Victoria Street, who installed the vacuum heating system for maintaining a temperature of 60 deg. Fah. in cold weather with an outside temperature of 32 deg. Fah. and an air filtration system for the paint dipping and paint spraying department. The heating plant consists of a Davy Paxman Economic boiler, 7ft. 6in. dia. by 14ft. 6in. long with a working pressure of 120 lb. per square inch and evaporative capacity of 5370 lb. from 212 deg. Fah. Steam to the heating system is reduced to 5 lb. by means of reducing valves, the steam consumption being 3000 lb. per hour when raising the temperature in the works to 60 deg. Fah. from an outside temperature of 32 deg. Fah. There are about thirty unit heaters, each having a capacity of 90,000 B.Th.Us., supplied by Dunham and Co., Ltd., of Merton, S.W.19, who also supplied the steam traps. A Worthington Simpson horizontal vacuum pump is installed, and is driven with steam from the boiler and controlled by a vacuum governor. The boiler and vacuum pump are housed in a separate building adjoining the factory, and it is stated that the whole system is giving satisfactory results.

General Lay-out of the Works

The lay-out of the manufacturing plant has been planned to give—as nearly as possible—straight line production, first of finished components, from the issue of material from the raw material stores to the finished parts stores, and from there to the assembly department and on to despatch of the completed units. All necessary operations and processes have been well thought out beforehand with little or nothing left to chance, so that the floor area allowed for each process has resulted in a well-balanced productive plant.

It will perhaps be possible to visualise the complete lay-out, and the methods employed, if a swift

survey is taken of each department in the order they are placed in to give correct sequence of manufacture, beginning with the raw material stores in which are stocked the cold rolled steel sheets delivered direct from British rolling mills. These are laid out at one extreme end of the building, and extend the full width of the manufacturing bays, having a length of 150ft. and width of 36ft., giving a total storing area of 5400 square feet. Entry to the stores is given from the main road, and material is delivered by motor lorry. A "Fuller" 2 ton overhead electric crane spans the width and travels the whole length of the store so that material can be placed in the position allocated, according to size and gauge.

There is no dividing wall or partition between the stores and the factory; they are full open from one end to the other, in order to facilitate delivery of material to the machines. Hence the somewhat unwieldy steel sheets can be lifted in bulk by the crane and run on trolleys direct to the machine, thus effecting a saving in labour and therefore a reduction in transportation costs.

Standing directly in front of the stores, and divided from them by a wide gangway are 10ft. guillotine shears driven by a 6 H.P. motor, and 8ft. shears driven by a 4 H.P. motor. These shears cut the standard sheets into exact sizes required to make specific parts, and with a view of preventing burrs or ragged edges on the cut sheets special attention is paid to the grinding of the shear blade, this work always being done on a micro grinder. Another point always carefully watched is the size of sheet selected for cutting up to make various parts, to reduce, as far as possible, the accumulation of scrap, but even so, the scrap amounts to an overall figure of 12½ per cent. with piercing and blanking scrap included.

Power Press Plant

Following the shearing machines come the power presses. There is a 200 ton multiple die press by Schuler, used for cutting and piercing plates at one operation, 8 ft. bending and forming presses, and three 12ft. Cincimata brake presses, all equipped with press dies and tools and all carrying out progressive operations of bending, forming, and piercing. Sometimes there are two and often three operators working on one machine with separate dies, and passing the metal from one to the other at each stroke of the press, which means that several operations are performed simultaneously in planned sequence, all as required to make a specified part.

An unusual type of machine designed at the works in America and installed here is shown in Fig. 8. This is a roller draw bench, constructed for drawing sheet steel through rollers, to form cavity sections by progressive formation, and used for making posts for steel doors and partitions. Strip sheet steel, cut to the correct width to form the section required, is drawn through a series of rollers much in the same way as wire drawing is done on a wire draw bench. Many different sections can be formed by providing suitably turned and hardened rollers of correct size and formation, which can be fitted to the machine in proper series to bend, deform, and reform the strip metal as it is drawn through them, until the last rollers in the series are passed and the section is completed. The draw bench is capable of dealing with a length of 40ft., but any intermediate length can be cut at will, with the motor driven Watkin cold saw seen in Fig. 8, standing at right angles to the draw bench. Many of the rollers held in stock for forming various sections are seen standing on shelves at the left side of the same engraving.

There are other features in this rolling and drawing machine that are worth noting. It is operated by a 30 H.P. electric motor through a friction clutch, and three sets of Vee pulleys are provided to give that number of speed changes, so that the speed or rate of draw can be varied according to the section being formed. There is also a separate motor fitted for quickly returning the draw carriage to the starting point after each draw has been completed, and the draw carriage is fitted with a quick-acting clamping device to secure it to the end of strip metal that is to be drawn through the rollers.

Some cavity sections made on this machine are seen in Fig. 3. These sections are assembled to form a metal base and post as used in the construction of partitions and doors by the firms. It will be noticed that the outer coverplates are removed to disclose the formation of the sections, and the provision made for carrying electric cables through the structure. These outer cover plates are designed to be held in place by friction without the use of bolts and nuts and they are easily removed and replaced.

Heating Chambers for Drying Paint

Proceeding still further through the factory towards the despatch end of the building we come to the dipping, spraying, and stoving plant, which is partly enclosed to render air filtration more effective. The plant here is very similar to that installed in the London factory and the process follows in the same sequence. The heating chambers are by Paul Meahler, of America, and are fitted with adjustable thermo-electric automatic control which can be set to maintain a constant temperature in the stoves. The heating unit is supported overhead and stands practically on a level with the top of the stove chamber; it consists of an oven built with fire bricks, and heated from the outside with gas jets, the heat being governed by the thermo-electric control. Air is passed through the interior of the heated oven, by means of an electric fan, and the hot air is conducted by ducts into the heating chamber and maintains the temperature required.

Stores and Assembly

After the storing process, all parts are conveyed to the stores by overhead runways and specially designed carriages on which are loaded a large number of parts. Some of these runways and carriages are seen in Fig. 4. All conveyance in the factory, from stoving to despatch, is effected by these overhead runways which are arranged to allow parts and also completely assembled units to be carried and deposited wherever required, either on the factory floor or on lorries and vans for despatch.

Conclusion

In the manufacture of steel office furniture and warehouse equipment in both the old and the new works, the key to the success attained is the rapid and accurate production of well-designed standard parts, made possible by equally well-designed and accurately made press tools which are the specialised product of the engineer and tool maker. In this class of manufacture the tools used are of paramount importance, and on them depend the accuracy and the rate of production; accuracy must be stressed because without it the efficiency of the assembly department would be adversely affected.

But a word must be said on the organisation of output. No factory can run smoothly without some measure of organisation, and as a rule the larger the factory and the greater the output the more perfect must the organisation be. Not that any organisation need be intricate or elaborate. The most effective form is usually the simple and direct method that allows production to run smoothly and quickly, and does not tend to hamper or delay by too much "red tape." In these works advanced planning has been found a simple and direct method of controlling output.

But there is also a social and welfare side that appears to be equally well looked after. At these works, there are sports, social, and sick clubs to which practically the whole of factory, office and sales staffs belong, and they are run on a contributory basis; both the employees and the firm contribute. They also have an annual dinner and annual outing, the latter being arranged by popular vote yearly. In all approximately 350 men are employed, to the majority of whom the social and welfare activities make a strong appeal.

The Future of Flying*

By H. E. WIMPERIS, Hon. D.Eng. (Melb.), F.R.Ae.S.

No. I

THE Presidential Address to the Engineering Section of the British Association provides each year an opportunity for a survey of some aspect of engineering science which happens to be of especial importance at the time it is given, and often one which the experience of the President of the hour may chance to render especially appropriate. My subject to-day is "The Future of Flying." Of its importance at the present time there can assuredly be no doubt. Aviation is surveyed by the public with a tempered pride—Pride, it is true, in man's achievement, but Apprehension, it is equally true, as to the use which is being made of it.

The aspiration towards winged flight was expressed, I submit, with great wisdom when, more than two thousand years ago, the Psalmist avowed his longing for "wings like a dove!" How wise a discrimination is revealed by the poet's asking not merely for the power of flight but that his wings shall be "dove-like." For the space of a generation mankind has possessed the power of flight—a marvellous scientific and technical triumph but, alas, incomplete. Brilliant as was the work of the brothers Wright, the crown of achievement will not be truly won until a grateful mankind sees that the wings gained are the wings of a dove and not those of a bird of prey.

This is the challenge to our age. One generation has solved the mechanical problem, leaving it to the next to solve the moral one.

Ever since man inhabited the earth he has lived not by his physical powers, which are slight, but by the exercise of his wits. Every new invention he has made has had its warlike use as well as its peaceful purpose, and each has challenged his wits to ensure that good rather than harm shall result from the new discovery. To bend the newest invention of all, the conquest of the air, to the service of mankind is now his great task. In it, success is essential lest we presently find that it is the air that has conquered mankind rather than mankind the air. Before we can regard the conquest of the air as achieved we must control the warlike menace.

In our own technical field, we as engineers have long been used to responsibility, to pioneer work, to expert status. But when it comes to the social application of our inventions, we are responsible not in our capacity as engineers but as ordinary inexpert citizens: and here we have been very conscious of our amateur status. We are not experts in the social application of our work; and we are but a handful among millions. This has been the view of the last generation—though held with increasing uneasiness, as the misuse of our inventions has become more apparent.

But it is possible that the conditions which formed this view are changing? May it be claimed—I think it may—that we as engineers, as technicians, have an important contribution to make towards the peace of the world?

I believe that the scientific advances of the present time, and their probable development in the near future, will help us to solve, and not to aggravate, our central problem—the task Lawrence of Arabia spoke of as "the biggest thing to do in the world to-day"—to bend the newest invention of all, the conquest of the air, to the true service of mankind.

Mechanical flight was achieved when Wilbur Wright flew in December, 1903, in that odd-looking machine now so proudly housed in the Science Museum at South Kensington. It certainly does look a queer machine to modern eyes. Although the engine weighed 180 lb. it gave but 12 h.p.! Of course it was natural that this, like all the other early aeroplanes, should be built with two pairs of wings. Engineers were well accustomed to carrying bending moments by a form of girder construction having an upper and a lower boom, and in the biplane form of construction the loads could be carried in this familiar way. Such early trials as were made of the monoplane type merely seemed to confirm the idea that a strong wing structure could not thus be found, and the biplane became the accepted type. Speeds in those days were low, and even long after the Great War it was thought that the attainment of high speed would be mainly a matter of putting in more and more engine power. More and more power was accordingly put in. This led indeed to the achievement of higher speeds, but far-sighted designers saw that there was a limit to the extent of progress by this means. But, as a Spanish proverb has it: "When one door shuts another opens." The new door in this case proved to be the streamlining of the external form of the craft as a whole.

That the cleaning up of the aerodynamic structure could carry performance much further than had hitherto been realised, and do so without any increase of engine power, was first clearly pointed

* Presidential Address to Section G (Engineering) British Association, Dundee, Aug. 31st.

out, little more than ten years ago, by Professor B. M. Jones of Cambridge. This required that all excrescences should be removed, and of these some of the worst were the interplane struts and wires. When that had been achieved it was realised that much of the equipment hitherto carried externally, especially in military types, must be put inside, and with that attained, after a severe struggle, there arrived the modern streamlined aeroplane with its undercarriage, and even its tail wheel, retractable into the body of the structure. What yet remained was attention to those external surfaces scrubbed by the passing air stream. Here guidance was given, curiously enough, by the experience of sailplane pilots, who had long found that a much better gliding angle was attainable when the surfaces were not merely made smooth, but were carefully polished, and even dusted before flight! At the time these minutiae of housemaid's care seemed fantastic, but experience, both within wind tunnels and without, showed that the sailplane pilots were right and that protuberances on a wing no more than a thousandth part of an inch high produced a measurable drag.

Flying To-day

The consequence of these and other changes in design from the original Wright machine brought a steady growth in speed, which during the last score of years has increased by an average of well over 10 miles an hour in each year.

This overall increase in aeroplane performance is indeed impressive: in speed from the 31 m.p.h. of the Wrights to the 469 claimed to-day! Behind the change in external characteristics there have been internal changes of an equally important character, such as the increase from the Wrights' wing loading of 1½ lb. per square foot to the figures of to-day when 20 to 30 and 40, and even more, are common. There has also been an equally impressive change from the modest engine power of the Wrights to the four-figure powers of modern practice.

So far as growth in altitude and range of flight are concerned, further progress must depend chiefly on improvements in the present-day materials of construction, or in the discovery of entirely new ones. At the moment dural is found best, not because it has any higher ratio of strength to density than alternative materials, for in that respect it differs little from steel, or even from cotton or reinforced plastic; but because in comparison with steel its lower density (little more than a third) enables thicker and therefore stiffer and more fool-proof sections to be used. But, as in the case of steel construction, the sections have to be fastened together with innumerable rivets (more than a million in one "Golden Hind"), and this time-absorbing process is both intricate and costly. If some improved reinforced plastic could be used instead, the path of the manufacturer, once he had learned the art, would be much simplified.

Speeds have grown because of the smoother shapes used in construction and through the greater engine powers provided. Can speeds continue to rise indefinitely? We may have gone almost as far as we can in using ship-shaped forms, though we still know very little about the possibility of ensuring an increase in the extent of the laminar flow of the air over the surface of wings or body: if this could be done the resistance would drop considerably. So far as prospective increases in engine power are concerned there is little publicly revealed in these days, but one hears of testing plants being adapted to deal with engines of no less than 3,000 h.p. apiece. But even with these increases a definite speed limit is being approached—not one imposed by the laws of any State but by the laws of Nature. As I pointed out two years ago in a Presidential Address to the Royal Aeronautical Society, there is good reason to believe that although speeds of 500 m.p.h. may be attained, it is unlikely that 600 will be much if at all exceeded, for the latter figure is some 80 per cent. of the speed of sound, and when the latter is approached the drag rises to a level far ahead of any prospective engine improvements. Although nothing in the physiology of man forbids even higher speeds, as witness the high orbital speed of the earth on which we all live with some measure of tempered comfort, there is soon imposed a physiological limit if high speed is combined with rapid manœuvre. If the latter is required then the speed must be controlled to suit the conditions. Only the future can reveal how the balance between the two will be struck.

No simple summary can be given of what has been done as regards engine development, for great as has been the change from the fifteen pounds per h.p. of the original Wright engine to the one pound, and less, of to-day, one remembers that in this one respect the engines of the last Schneider Trophy Race were as meritorious; where the latter were much below modern standards was in their lack of reliability when working at this power ratio. To-day's engines run without attention for hundreds of hours, a very different matter from endurance for a short race.

Even if engines of 3,000 h.p. may be said to be in sight they are still some way from achievement. Progress depends not only on the skill of the engine designer and the metallurgist, but on the ingenuity of the industrial chemist in producing his remarkable fuels, wonderful alike for their uniformity of quality and for their ability to resist detonation even when employed in engines of very high compression ratio.

The outstanding constructional change to-day is the employment on a large scale of the sleeve valve, particularly as developed by the great Bristol firm. This has the impressive merit of only needing half the component parts of the old type poppet valve engine; moreover it is found that, with a given fuel, it can operate without detonation at an appreciably higher compression.

Engines to-day run safely at far higher speeds than of yore, and they are cooled in different ways and at a much less expense in air drag than used to be the case. In fact at the highest speeds the drag offers some theoretical promise of being replaced by a small thrust! A new cooling problem will arise, however, when pusher airscrews become as common as they will once their use is shown to afford a means of substantially decreasing wing drag.

Improvement in load carrying capacity depends also on improvements in materials, though it is fair to designers to record the progress made in reducing the percentage which the structure forms of the total flying weight in modern aircraft. Nowadays as good a figure is shown for this in large flying-boats as in landplanes, a remarkable achievement. The flying-boat used to be thought of as slow and heavy, but to-day it holds its own, in efficiency, whether aero-dynamic, structural, or economic, with any other mode of flight.

The flying-boats of to-day represent a great technical advance in quality over their predecessors of ten, or even five, years ago, but they have not yet shown any marked advance in size. The fine fleet of Empire flying-boats is made up of 20-ton units; the new Short "Golden Hind" class for the Atlantic weigh 33 tons apiece; the Boeing "Yankee Clipper" has a total weight of nearly 40 tons; but the Dornier DO.X. which long preceded them ran to 50 tons laden. On the other hand there has been a great gain in speed and in carrying capacity. The Boeing boat, for instance, is reported to carry 10,000 lb. of load over and above its 4,000 gallons of fuel: as this amount of fuel will weigh 30,000 lb., this makes a total load of 40,000 lb., or almost exactly half of the total flying weight, the same as for the "Golden Hind," and a truly remarkable percentage. The improved Empire flying-boats intended for the Atlantic crossing are planned to take-off at a flying weight of about 20 tons and to take 3 tons of additional fuel after they are air borne—by supply from a flying tanker on Sir Alan Cobham's scheme: this will increase the load on the wings from 30 to 35 lb. per square foot and may be regarded as a first step towards what could be done with wings specially designed and stressed for high loading. The "Golden Hind" class is designed for a range of 3,400 miles without refuelling, and this with full load. Its early programme may include a survey flight along the route to Latin America.

An attractive development in flying-boats is the provision in the Dornier DO.26 of retractable wing-tip floats which fold inwards into spaces in the wing. This is a 20-ton machine with two tractor and two pusher airscrews. It is a promising move in a very much desired direction. The remaining structural feature to be made aerodynamically clean is the "step" at the hull provided for ease in taking-off. It is no doubt difficult so to design a hull as to be equally efficient whether on the water or in the air, but designers will not be happy until they have satisfied both requirements.

It is naturally impossible in the course of this address to discuss all the many problems in the science of aeronautics which are being investigated at the present time. They are far too numerous and the time too short. But to some of them I must refer. One of great importance and quite fascinating interest is the investigation of the change in the air flow over a wing surface from the laminar to the turbulent state. It is known that if the flow could be kept laminar the drag would be vastly reduced, but it has yet to be discovered how to do this. A step in the right direction may lately have been made at the Langley Field Laboratories, for during Dr. Lewis' recent Wilbur Wright lecture before the Royal Aeronautical Society, mention was made of some wind tunnel tests in which a special form of aerofoil gave a drag coefficient figure of only about one-third of that usual. Further particulars will be awaited with interest. Many laboratories and experimental stations are studying this same problem, and, as not infrequently happens in such cases, success once met with, itself creates a batch of new problems. For one thing it is clear that the presence of laminar flow can but be hindered by the use of the tractor type of airscrew now almost universal. It may be necessary to change to pusher designs, and as this will involve a marked rearward movement of the centre of gravity of the whole aircraft, all the stability factors will be gravely affected, to say nothing of the many engine problems also raised.

Other special problems relate to the possibility of having wing areas adjustable in flight by telescopic or other means, to the study of the very considerable increase in the control forces required of the pilot in large machines of high speed capacity, of the special problems raised by variable pitch airscrews, particularly in relation to the landing run, of the advantage at high air speeds of two-speed gear boxes, and of the special problems involved in pressure cabins.

The problem of the rotating wing is in a class by itself. Aircraft so fitted are quite unable to compete in speed with those with normal wings, but they easily beat the latter in take-off and landing. Many types are now in the field, the Cierva, the Hafner, the Kay and the Focke, to mention no others. The scientific problems are largely solved, as are the great mass of the mechanical ones. What is required is such a degree of user as will call for this form of aircraft to be constructed in numbers. When that happens rotary wing aircraft will benefit in their design by that skilled attention from the production engineer which alone seems able to produce results that really look right!

The growth in recent years of the interest taken by the public in aviation, over land and over sea, is most striking. Partly, of course, it is due to the increase in the Air Arm and all that is thereby implied. But there is also a very rapidly growing use being made of the abundant facilities for air travel offered by the Civil air transport services. The United States is often thought to lead the world in this respect—as it certainly does in the use of the automobile—but I believe that in proportion to the size of the population, and that is the true criterion, the total mileage flown annually is larger in Australia than it is in any other single country in the world. And there is good reason to expect that that pre-eminence is likely to continue.

The Future Years

Let us consider what lies ahead in the coming years in respect of speed, size and range. No doubt military craft will go as fast as they can. But since it seems that they cannot exceed 600 m.p.h. much if at all, there is little doubt that speeds between 500 and 600 will become usual. Not so, however, for the Civil Air Services, where quiet, comfort and cost are all-important: here there is good economic reason for speeds to settle down in the 200 to 300 range. In both these classes we seem therefore to be approaching some degree of finality.

Altitude and range are alike in that so much depends on the discovery of new materials of construction and new ways of using them. Steady progress may be expected, though probably nothing sensational unless the use of reinforced plastics be so reckoned. For civil work the advantage of long-range flying depends on the ability to fly by night, and this is advancing rapidly. Radio services are improving and the vagaries of the ionosphere are becoming better understood. High altitude flying—whether in the stratosphere or just below it—requires the sealed cabin, and it will, I fancy, chiefly be sought by those whose first care is speed and whose lesser concern is cost.

When, however, we come to think of such other factors in the future of flying as the size of the craft, and the wing loading employed, we are concerned with quite other considerations. Size depends mainly on engine power, for there is a limit to the numbers of power units which can be conveniently looked after. Even if we have tractor and pusher airscrews in tandem (and tractor screws may well become unpopular where the highest aerodynamic

efficiency is sought), six such pairs may be the practicable limit. This would give us twelve engines, which, at 3000 h.p. apiece, makes the total power 36,000. At 15 lb. carried per h.p. available this would give a total flying weight of 540,000 lb. or some 250 tons. Such a craft would naturally be a large boat, taking 200 passengers or more; and that is the largest flying craft that can be said to be now in sight, although I ought perhaps to mention that in a lecture to the students of the Royal Aeronautical Society, who alone perhaps might be expected to live to see it, Dr. Roxbee-Cox was bold enough to include an American forecast for a boat of 3120 tons! But difficult as it may be to foretell accurately the future of the large flying-boat, there can be little doubt that we shall soon see such craft in active competition with their older rivals—which use the surface of the sea—for all rapid passenger transport on the important Atlantic routes.

The future of wing loading is hard to forecast. As has been mentioned, the early Wright aeroplane was loaded to 1½ lb. per square foot. By the time of the Great War this had risen to the neighbourhood of 10, but even Hallam ("Pyx"), writing as prophet a few years later of his vision of a 200-ton flying-boat, did not put it above 8! In the succeeding years, however, the figure has grown gradually until it is now in the neighbourhood of 30; and while loadings of 40 to 50 are talked about for future craft, Sir Alan Cobham has suggested that, provided the bulk of the fuel is added by refuelling in the air from a tanker, loadings as high as 60 or even 70 should not be unattainable. The real limiting factor here is the take-off and the landing. With landplanes, the disadvantage of high loadings is that they lead to great increase in the size and cost of aerodromes, unless this can be avoided by the use of an auxiliary like the Mayo Scheme or by some form of catapulting, or by the use of the "tricycle" undercarriage, now so rapidly coming into use. This consequence of high loadings does not apply in the same degree to the flying-boat, but even there it has the disadvantage of requiring the use of natural harbours of large size with not too much local water traffic.

Can one, however, relate these speed ranges of 500 to 600 for military craft, and 200 to 300 for civil, with wing loading, with or without refuelling in the air? We have the relationship that the minimum air speed of flight is measured by the square root of the wing loading. If we assume the use of such aids as wing flaps, we can calculate for sea-level conditions just what the stalling speed for any given wing loading must be.

For a take-off speed of 100 m.p.h. (*i.e.* stalling speed of 80) the wing loading would be about 40 lb. per square foot, suitable for civil types having a top speed of, say, 300 m.p.h. (since the take-off and landing speeds would then be about 100). But once in the air a much larger load could of course be carried.

In the case of military types having top speeds of 550 m.p.h. or thereabouts, the landing speed could hardly be less than 150, giving a wing loading of 100 lb. per square foot. It looks therefore as though in the coming years the wing loadings for civil types will go little beyond what is now planned in many drawing offices, but in the case of military types the present-day figures may certainly be doubled unless some new wing arrangement can be discovered which will greatly reduce the loading figure when a landing is about to take place. Rotating wings are the perfect solution for the landing problem, but how to combine them with means for the attainment of high horizontal speed is a problem which the future has yet to solve. The one recent development—or revival—which seems to promise a great advance in safe landing is the tricycle undercarriage: the use of which seems to be almost all pure gain. In a lecture before the Royal Aeronautical Society last year, Mr. H. F. Vessey expressed the rather conservative view that although with land planes of the normal type it is difficult to see any considerable increase in wing loading at landing above about 30 lb. per square foot, if present restrictions on landing distances over a barrier are to be maintained, nevertheless he admits that by the use of the tricycle undercarriage the loading might go as high as 40.

It is odd that chance should decide—or perhaps appear to decide—the future of so many forms of human activity. Almost at its birth, broadcasting fell into good hands, and the cinema into bad, but aeronautical research, very fortunately, into good. I can imagine a critic remarking that it was not quite all chance: that broadcasting was preserved by the Post Office control over radio, and that organised aeronautical research owed everything to the wise foresight of the late Lord Haldane, who caused there to be created an Aeronautical Research Committee with funds for research workers and apparatus for them to use.

Fortunate it was indeed that research in aeronautics was so wisely led and adequately supported. It was a new science, and one of the few happy results of the Great War was that it drew into this service some of the most brilliant young scientific men of the day, especially from the universities of Cambridge and Oxford. And this interest held, for even now the leaders are largely drawn from that band of pioneers. In their early work they were happy in their hour, for almost anything that was done was necessarily original and almost any invention was bound to be new: there was little need to consult the records of the past. The Aeronautical Research Committee was, and still is, mainly drawn from these men and those they have trained. With the support and confidence felt in them by the Government, they were able to develop ideas, whether arising from their own ingenuity or from workers and industrialists outside. It was an example soon copied by the United States, and its latest adherent is Australia, the newest country to take up aeronautical engineering as a serious national effort.

It is impossible not to be struck by the stimulus which this specially directed scientific research work has given to other branches of engineering. It represents the spearhead of attack in applied science, since so many of its problems arise from practical conditions of unusual difficulty, owing to the intensity of the desire for light construction, combined with strength and durability, and for very high efficiency factors. It is hardly surprising therefore that such apparently non-aeronautical fields as the design of steam turbine blades, of power boats, of industrial fans, of light vehicles should owe so much to the results of aeronautical research.

(To be continued)

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

DANZIG

SIR,—Is it not possible that engineers could help to provide an acceptable solution to the Danzig problem? Poland's great concern at the threatened German occupation of Danzig is said to be the ease with which Gdynia could be bombarded from the Danzig water front, but if instead of a motor road across the Polish Corridor, a high-level road and railway bridge could be constructed from the western boundary of Danzig to the Hel peninsula this would serve as a screen to Gdynia which could only be shelled at the risk of destroying the bridge, or in other words the communication between East Prussia and Germany. From the Hel peninsula a road and railway would be required along the Polish foreshore, carried on bridges or viaduct, or tunnelled where necessary to avoid interference with Polish interests, but in general these communications could doubtless be constructed in such a manner as to be dominated by the weaker nation, and if the bridge foundations were on Polish territory or in Polish waters, the bridge would also be under Polish domination. A suspension bridge would probably be the most suitable type because it would be unsuitable for gun emplacements.

If the right influences were encouraged during construction, the psychological effect should also be excellent and the finished structure prove a veritable "bridge of peace."

J. D. W. BALL,
Assoc. M. Inst. C.E.

London, August 29th.

Sixty Years Ago

TRACTION ENGINES IN INDIA

IN our issue of September 5th, 1879, we reprinted a paper entitled "On the Working of Traction Engines in India" which had been read before the Institution of Mechanical Engineers by Mr. R. E. B. Crompton. This paper is to-day almost as famous as its venerable author. Lieutenant Crompton, as he then was, had been placed in charge of some experiments on "road steamers" in the Punjab, which the Government of India had initiated. The experiments were inspired by the success obtained by Mr. R. W. Thomson, of Edinburgh, with his rubber-tyred traction engines. Five of these engines were purchased by the Indian Government and for three years, 1873 to 1875, a regular service of road trains was maintained between two towns for six months each year. Lieutenant Crompton had been sent home to England to superintend the construction of four of the engines at the Ipswich works of Ransomes, Sims and Head. The engines had three wheels and vertical "Field" boilers. Originally they carried their own fuel and water and when fully laden weighed 15 tons. That weight was in excess of the limit allowed on the timber bridges of the roads on which the engines were to operate in India. Accordingly the design was modified and the engines were equipped with tenders carrying five tons of fuel and water. As a result the engine weight was reduced to 9 tons. Much of the success which they achieved was attributed by Lieutenant Crompton to the rubber-tyred wheels with which the engines were fitted. The driving wheels were 6ft. 6in. in diameter and the leading wheel 3ft. 10in. The tyres were originally held in place between two low flanges, one of which was detachable, and were made of soft gray rubber by the North British Rubber Company. They were protected by external armour consisting of 5in. by ⅛in. steel plate shoes connected by malleable cast iron links. These tyres gave great trouble and were replaced by a form invented by Mr. R. W. Thomson consisting of a number of separate rubber shoes clipped to the periphery of the wheel. This new form of tyre was an improvement, but it had to be modified in India before it became a practical success. The rolling stock hauled by the engines was built in India. The first engine arrived from England at the end of 1872 and the others followed at later dates. The early trial runs were attended with a certain amount of tribulation. A driving wheel came off once. Twice the train became uncoupled, and on one occasion the driver became drunk and drove the engine off the road, turning it over and doing damage which with the limited repair facilities available was difficult to make good. However in the end gratifying results were obtained. A Government committee investigated the performances of one of the engines. It found that it could draw a train weighing 64 tons—or with engine and tender 77 tons gross—up an incline of 1 in 33 at a speed of five miles an hour. With a train arrangement consisting of four-wheeled and two-wheeled vehicles alternately no difficulty was encountered in manœuvring round curves or into confined spaces although at high speeds the train showed an inclination on the part of the rearmost vehicles to follow a serpentine course. Lieutenant Crompton stated in conclusion that on the level roads of India traction engines could be relied upon to work a service of trains with great regularity and at a fair speed. Goods, he said, could be carried at 4 miles an hour and passengers at 8. At those speeds the cost of running a train carrying 15 tons of goods or about 7 tons of pasengers was about 2*s.* 2*d.* per train mile. The cost of maintaining the rubber tyres was about 1½*d.* per train mile.

American Concrete Research Work

Studies of various aspects of concrete construction were reviewed at the annual meeting of the American Society for Testing Materials, although no new standard specifications were submitted. In two new methods for determining free lime in cement, one uses glycerol as an accelerator while the other uses either barium chloride or sodium chloride. There is also a new test for the soundness of coarse aggregate by the use of magnesium sulphate. This is important since investigation of gravel-concrete paving which has failed by scaling and disintegration indicates the use of an unsatisfactory kind of gravel as the main cause. In lean concretes, increased fineness of cement is found to improve the workability provided there are at least four bags of cement per cubic yard. It also increases the compressive strength in 7-day tests, but is less effective in the 28-day and 3-month tests. On the foundations for the Whitestone suspension bridge at New York, sulphate-resistant cement was used, with six sacks per cubic yard, while concrete exposed to the sea had not more than six gallons of water per cubic yard. In farm silos, concrete is subject to the corrosive action of acetic acid and lactic acid. Tests with nine different cements showed that the most satisfactory of both ordinary and high-early-strength cements are those which are highly resistant to solutions of sodium and magnesium sulphate. Another line of investigation is the permeability of concrete by liquid in fluid form, as capillary evaporation moisture, and by water-vapour movement. It appears that capillary movement of water through concrete may be greater than that of free water at ordinary heads. Concrete containing water-repellant materials is more resistant to capillarity than concrete made with standard cements, due to the fact that the surface tension characteristics of the former have been altered. High-strength cement is found to increase watertightness in proportion to its increase in the compressive strength of the concrete.

Rail and Road

STEEL PRODUCTION IN EIRE.—New steel mills recently opened at Haulbowline, Cork Harbour, in Eire are said to be capable of supplying the country's entire steel requirements.

"MODEL ENGINEER" EXHIBITION.—The organisers of the "Model Engineer" exhibition announce that the exhibition has been postponed. If circumstances permit it will be held on January 4th–13th, 1940.

ANDES RAILWAY TUNNEL.—As part of the Pan-American highway it is proposed to recondition the railway tunnel through the Andes Mountains, which connects Argentina and Chile, to accommodate highway traffic.

MOTOR EXHIBITIONS.—The Society of Motor Manufacturers and Traders, Ltd., states that in view of the state of war declared on September 3rd, neither the Motor Exhibition in October nor the Commercial Motor Transport Exhibition in November will now be held.

IRISH RAILWAYS COMMITTEE.—In connection with the report of the Joint Select Committee on Transport in Northern Ireland, a special committee has been appointed by the Irish railways to deal with their interests. The following four gentlemen, who are the chairmen of the railways concerned, comprise the committee: Mr. James Hurst, Lord Glenary, Mr. T. Somerset, and Capt. George Hewson.

L.N.E.R. SCOTTISH AREA LOCOMOTIVE RUNNING DEPARTMENT.—The London and North Eastern Railway Company has transferred the headquarters of the Scottish Area locomotive running department from Glasgow to Edinburgh. District locomotive running superintendents have been appointed at Glasgow, Edinburgh, and Burntisland, with office staffs organised on a joint basis with the district superintendent at Glasgow and the district operating superintendents at Edinburgh and Burntisland respectively.

USE OF GOODS VEHICLES FOR DEFENCE PURPOSES.—The Minister has now made the Road and Rail Traffic Act (Exemption) (Amendment) Provisional Regulations, 1939, which exempt from the licensing provisions of that Act the use for manning of any war stations in anticipation of enemy attack and the mobilisation of the fighting services, of any vehicle hired by naval, military or air force authorities for naval, military or air force purposes; and the use of any vehicle by a local authority in discharge of its civil defence functions.

TROLLEY BUSES.—In an article on trolley bus progress in the *Electrical Review*, Mr. J. H. Cansdale points out that in 1922 there were about 75 trolley buses and 14,300 tramcars in service in this country. By 1938 there were 2600 trolley buses and 8900 tramcars in service, and the number of trams and tramway mileage is now rapidly decreasing. Mr. Cansdale says that modern tramcars are operating satisfactorily in several large cities, and no change-over is contemplated, but a number of places operating small systems with obsolete cars and equipment have for the most part already closed them down. It is among these latter systems that the motor-bus has been substituted more often than the trolley-bus, so that over the past 17 years, although 4200 trams have been scrapped, only 2500 trolley buses have been installed.

EMERGENCY ORGANISATION OF ROAD TRANSPORT GOODS VEHICLES.—The Secretary to the Ministry of Transport announces that operators of goods vehicles licensed under "A," "B," or "C" licences under the Road and Rail Traffic Act, 1933, who have not registered their vehicles in the emergency index or have not joined groups are advised in their own interests to do so at once. They can still put this right by applying either to Regional or District offices of the Ministry of Transport. If fuel rationing becomes necessary it will not be possible for operators to obtain fuel for vehicles not registered in the emergency index. Owners of ungrouped vehicles (except vehicles specially exempted from grouping) will inevitably be placed at a disadvantage in operating their vehicles, and cannot expect the same consideration in matters affecting the operation of their vehicles as those who form part of the emergency organisation.

NEW RAILWAYS IN U.S.S.R.—A further new line, 210 miles long, linking one of the largest industrial centres of the U.S.S.R. with the trans-continental lines of Kazakhstan and Asia has just been completed and taken over by the Soviet government. Running from Ridder to Rubtsovka, it directly links up the Irtysh copper-smelting works, the Belouso mine, the Ulbin hydro-electric power station, and the Irtysh hydro-electric power station—with Siberia. Along its route several lead and zinc works are now in course of construction. It is also understood that construction is to begin this year on a railway from Kazan to Bugulma to improve communication between western Siberia and the European portion of the U.S.S.R. south of the Trans-Siberian route between Moscow and Sverdlovsk. A 520-mile line is also to be built to the east of the southern part of the Urals to connect Akmolinsk and Kastaly, and thus give a direct route between the Karaganda coal basin and the mineral area round Magnetogorsk.

THE RAILWAYS OF BULGARIA.—In an economic and commercial report on Bulgaria, Mr. T. V. Brenan says that the total length of lines in use at the end of last year consisted of 2917½ km. of standard-gauge, 206 km. of 76 cm. gauge, and 228 km. of 60 cm. gauge, all owned and operated by the State Railways. In addition, the State Railways exploited 10·6 km. of privately-owned line, while lines totalling 50·3 km. were owned and operated by private undertakings. During the year constructional work continued on the standard gauge Karlovo-Kazanluk, Bourgas-Pomoré, Shumen-Gantchevo, Karnobat-Prilep, Kroumovo-Preslav, Dolen Tchiflik-Stara Orechovo and Sofia Circle sections, over a distance of 254 km. and also on 19 km. of the Yakorouda-Istok narrow-gauge (76 cm.) section. It was at first anticipated that by the end of the year 148 km. of standard-gauge line together with the narrow-gauge section, would be completed, but circumstances intervened to prevent this from being accomplished and only 7½ km. (Kroumovo-Preslav) were actually opened.

Miscellanea

THE LATE MR. H. G. RIDDLE.—It is with great regret that we have to record the death on August 26th of Mr. Herbert G. Riddle, the Secretary of the Junior Institution of Engineers (Incorporated). Mr. Riddle was about to retire after having completed 21 years of service.

TREFOREST TRADING ESTATE.—There are now one hundred tenants of factories on the Treforest Trading Estate in the Special Areas of South Wales. More than half of these factories are in production and about 18 of them are producers of electrical, metal, and light engineering goods. More than 1000 men and 280 boys are employed and 650 men are working on developing and constructional work on the estate.

A GLASS PUMP.—The Corning Glass Works in the United States has developed a centrifugal pump made entirely of glass for the handling of corrosive liquids. Its casing, impeller and all parts in contact with liquid are of clear, transparent, heat- and shock-resisting glass. The rotor is accurately balanced and runs at high speeds without vibration. The pump has a capacity of 6000 gallons per hour and handles liquids at temperatures up to 150 deg. Fah.

WASTE NATURAL GAS.—The National Research Council of Canada reports that one of the most striking pieces of work of the last few years relates to the utilisation of waste natural gas. It has been found that by heat treatment in a furnace of a special but nevertheless simple design, the fraction of waste gas known as stabilizer gas can be made to yield 3 to 4 gallons of liquid motor fuel of the benzol type per 1000 cu. ft. of gas. The striking result has now been secured that the residual gas from such heat treatment will yield 6 to 7 lb. of carbon black. This combination process seems to have attractive commercial possibilities.

BELFAST ELECTRICITY SUPPLY.—Reports state that the Electricity Committee of the Belfast Corporation is considering the provision of a duplicate electricity power station at an estimated cost of over one million pounds. Strong representations are being made by the Northern Ireland Government, in view of the Civil Defence scheme, to secure a site for a duplicate station some distance from Belfast. The Electricity Committee of the Corporation has already accepted the principle of purchasing new plant before the site is found, and it may seek the Corporation's approval to expenditure for this purpose of over £300,000 at an early date.

THE B.E.A. IN WAR TIME.—The British Engineers' Association has decided to remain in action in its present quarters, in London, unless compelled to evacuate them by Government order or by war damage or dislocation, in which event removal to other quarters would have to be considered by the Council. As matters now stand the Association's normal services are available to its members, who it is hoped will make use of them so far as they may be applicable in the circumstances of war. The Association hopes to be able to render services of special value by functioning as a focal point in London in close touch with the Government Departments and other authorities, with which it will provide a ready means of communication.

DATA ON ELECTRIC ARC WELDING.—In a paper on electric arc welding, read before the American Iron and Steel Institute, Messrs. Haster Hodge and Schoessow said that while the weldability of steels with respect to composition is generally understood, exact knowledge is lacking, especially when the steel contains more than normal amounts of an additive alloying element, as for example, manganese. Experimental work in quantity will be necessary before limiting compositions with respect to weldability under various techniques can be definitely established. Simple tests necessary for economical exploration of this experimental field are now in process of formation although no standards have as yet been adopted. The most likely tests involve a study of the heat-affected zone of the parent metal resulting from deposition of a single bead of weld metal under controlled conditions. The bend tests of such weld specimens, together with determinations of the maximum weld hardness, appear to be the simplest and best criteria.

OIL REFINERY EQUIPMENT IN CANADA.—At a recent meeting of the Border Cities Branch of the Engineering Institute of Canada, some interesting facts were presented concerning equipment in the Imperial Oil Refinery at Sarnia, Ontario. In this plant carbon steel has the preference. Stainless steel is used only where the sulphur content of the crude oil is high but creeps badly at high temperatures. This factor is considered very important since the design is based on creep or elongation and not the ultimate stress of the material. High pressure and high temperature equipment is protected against erosion by the use of a 2in. layer of cement. This layer has an insulating property as the temperature drop across it may be as high as 100 deg. at temperatures of 900 deg. Fah. It consists of a one to one mix and is put on by the use of high-pressure spray guns. The steel is sandblasted before the application and the concrete is laid over reinforcing steel which is bonded to the steel body. A life of two years is given and the layer may be patched during that time. The bond to the steel is usually very good even after two years at 900 deg. Fah. The large tubes thus protected in the oil cracking furnaces are cleaned monthly. Large shrinkage cracks appear on cooling the units. They are welded and the weld stress relieved before the units are put back into operation. The soaking towers are of seamless steel construction and they, also, have the concrete coating inside. They operate at 1000 lb. pressure and 1050 deg. Fah. temperature, and are rigidly inspected at short and regular intervals. This inspection comprises calipering the metal for thickness, a pressure test of 11,000 lb. per square inch, a hammer test, and an elongation test. Inspection holes are drilled through the metal and are later filled with screwed plugs. These plugs must not protrude inside the tube or coke will form over this point and the resulting abnormal temperature will eventually lead to failure. The protective coating of concrete is also used on the low-pressure equipment where blistering of the carbon steel takes place owing to acid.

Air and Water

A RECORD TRANS-ATLANTIC FLIGHT.—A new record for a trans-Atlantic flight has been set up by the Imperial Airways flying-boat "Cabot" which flew from Southampton to Montreal in 27 hours 51 minutes.

NEW ZEALAND AIR MAIL.—The flying-boat "Aotearoa," which left Southampton on August 16th to take part in the new weekly air-mail service between London and New Zealand, arrived at Auckland on the afternoon of August 28th from Sydney, having crossed the Tasman Sea in 8 hours 3 minutes.

MAGNESIUM FROM SEA WATER PLANT IN ITALY.—It is reported that an Italian company is to build a plant for the manufacture of metallic magnesium from magnesium chloride derived from seawater. The plant will be built on the Ligurian coast and will have an initial annual capacity of 1,200 tons, later to be increased to 3000 tons.

LAUNCH OF THE "AMERICA."—The new passenger liner "America" was launched at Newport News on Wednesday, August 30th. Early next year she will enter the Hamburg–Havre–Southampton–Cobh service of the United States Lines to New York. The new ship has a length of 723ft., a beam of 93ft. and a depth of 75ft., and has accommodation for 1219 passengers.

PROPOSED NEW ATLANTIC–PACIFIC CANAL.—A board of engineers has left the United States to survey and study the route of a proposed shallow draught barge canal across Nicaragua from the Atlantic to the Pacific Ocean. The eastern end of the canal will be formed by canalisation of the San Juan River between the Atlantic and Lake Nicarugua. It is proposed that the canal shall be capable of taking barges of 10 to 12ft. draught.

DEATH OF MR. J. B. HENDERSON.—It is with regret that we note the death of Mr. J. B. Henderson, who for more than thirty years was Clydebank secretary of John Brown and Company, Ltd. He was associated for nearly sixty years with Clyde Shipbuilding having started his career in the offices of the Finnieston engine works of J. and G. Thomson which firm later transferred all its departments to Clydebank and was later taken over by John Brown and Company, Ltd.

AMERICAN NAVAL AIR BASES.—Some time ago the United States Congress authorised the expenditure of nearly 67 million dollars on air bases to be spent within the next three years. The first contract for new and enlarged bases in the Pacific Ocean has been placed. The work covered in the contract includes new bases or additions to existing facilities at Kaneohe Bay, Hawaii; Pearl Harbor, Hawaii; Midway Islands; Johnston Island; and Palmyra Island.

BULGARIAN–RUMANIAN TRAIN FERRY.—It is expected that the connection between the Bulgarian and Roumanian railway systems should be established by the end of 1939, by means of a train ferry service across the Danube between Roustchouk (Rousse) and Giurgiu. The ferry-boat for the Bulgarian State Railways, which is being built in Germany, at a cost of 24 million leva, should be delivered in October, by which time the Bulgarian shore constructions, costing about 28 million leva, will also be ready.

THE BIG SOVIET AEROPLANE.—Further details have been issued of the size and equipment of the large new aeroplane USSR-L-760 which recently made its first flight. The machine has a wingspan of 206¾ft., a length of 111¼ft., and a height of 25¼ft. The six engines of the plane develop between 7000 and 8000 H.P., and the normal weight of the machine, fully loaded, is approximately 45 tons. It has a radius of 932 miles and accommodation for a crew of 8 and 64 passengers.

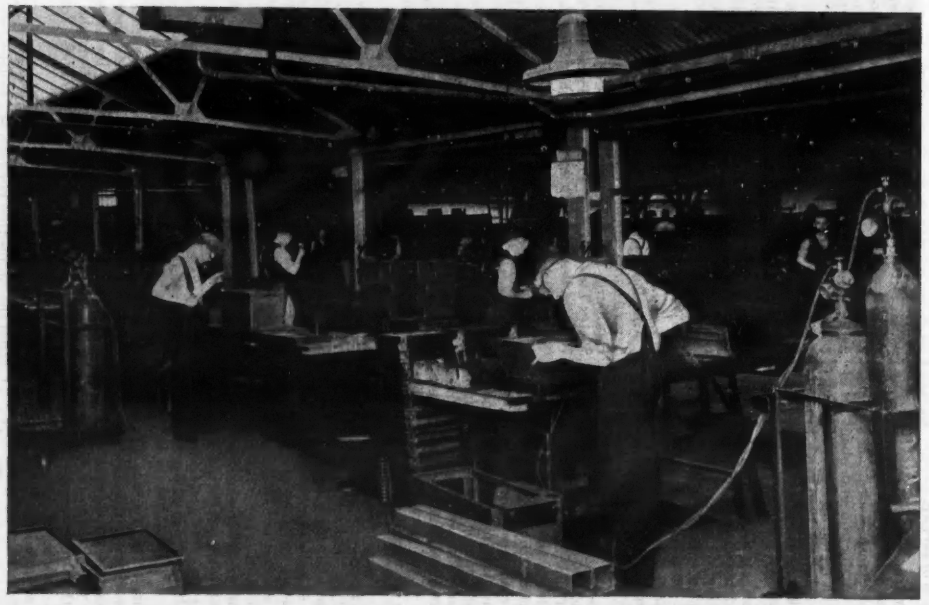
CONTROL OF JAPANESE SHIPPING.—A company to be called the Toa Kaiun Kaisha, or East Asia Shipping Company, with a capital of 73 million yen, is to be established jointly by the shipping interests in Japan to coordinate and consolidate the country's shipping. The company will manage maritime transportation between Japan and China in Chinese coastal waters, and between China and other countries, and manage wharves, warehouses and investments in enterprises connected with shipping.

BAKELITE FOR PROPELLER SHAFT LINERS.—A note in *Bakelite Progress* says that propeller shaft liners for passenger and merchant vessels when made from lignum vitæ have a life of approximately two years, which, in view of the arduous conditions of service, has, hitherto, been considered to be fairly satisfactory. Observations have recently been made on the life of bearings for this particular application when made from Bakelite laminated material. About a year ago a stern shaft liner of this type was installed, and inspection after this period of service showed that the laminated bush had worn about $\frac{1}{32}$ in., and as replacement is normally undertaken at ¼in. wear, the bush should be good for several more years of life. Another potential application for this grade of Bakelite material in the shipbuilding sphere is considered to be for pin liners on rudder brackets.

TRAFFIC ON CANALS AND WATERWAYS.—The total traffic on British canals, exclusive of the Manchester Ship Canal, for the first six months of this year amounted to 6,307,116 tons, compared with 6,645,728 tons in the corresponding period of 1938, and 7,280,573 tons in the first six months of 1937. On the railway-owned canals the tonnages show decreases in most instances, but the returns for the independently owned canals, according to the Ministry of Transport, are satisfactory. Last year the Aire and Calder carried 1,245,420 tons, the Birmingham Canal 1,040,376 tons, the Lee Navigation 967,980 tons, Grand Union 895,838 tons, and Leeds and Liverpool 739,881 tons. Independent canals and waterways during the first six months of this year carried the following traffics: Coal, coke, patent fuel, and peat (2,957,290 tons), agricultural produce and foodstuffs (576,648 tons), industrial products (530,544 tons), building materials other than wood (444,964 tons).

WORKS OF THE ART METAL CONSTRUCTION COMPANY

(For description see page 252)



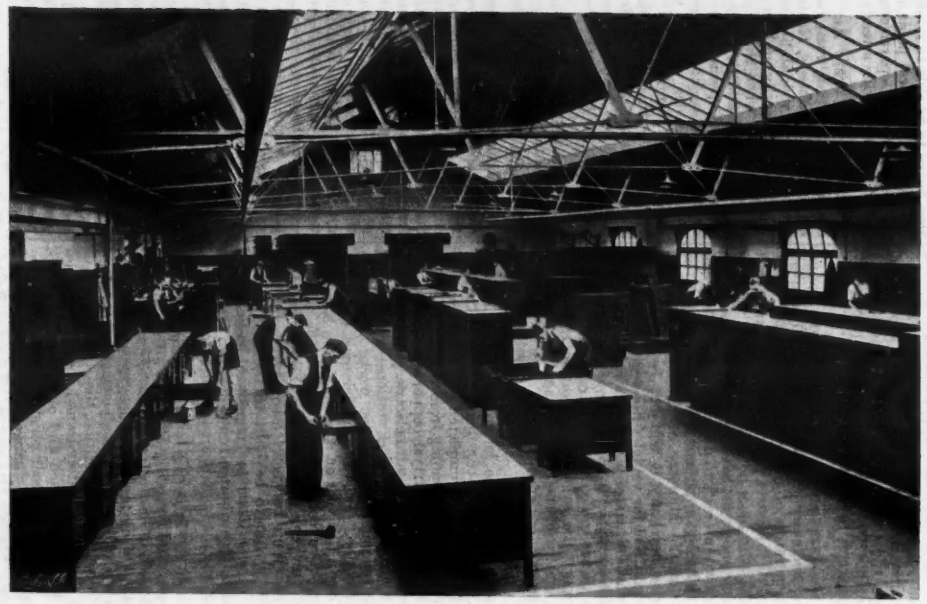


FIG. 5—MACHINES AND WORK STANDS IN PRESS SHOP

FIG. 6—WELDING SHOP

FIG. 7—ASSEMBLING ROOM

FIG. 8—ROLLER DRAW BENCH

The Engineer

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**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

CHANGES OF ADDRESS

**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both the old and new addresses,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

Postal Address : "The Engineer," 28, Essex Street, Strand, London, W.C.2.

Telegraphic Address : "Engineer Newspaper, Estrand, London." Telephone : CENtral 6565 (10 lines).

THE ENGINEERING AND MARINE EXHIBITION OLYMPIA

The biennial Exhibition which was due to open on September 15th at Olympia, London, cannot be held this year, and no one can foresee when the series will be resumed.

Following our usual custom we had made preparations for the publication of two special supplements describing the exhibits. For that purpose we have already collected from exhibitors particulars and illustrations of the novel features that they had intended to show.

It seems desirable to us that, in the interests of the engineering and allied industries, these particulars should be made public, and we propose to print them, as space permits, in these columns.

As it is difficult in the present circumstances to keep touch with all who have sent us material for these special numbers we ask those who wish that descriptions of their proposed exhibits shall *not* be published, to inform us at once, addressing their letters to the Editor, THE ENGINEER, c/o Wm. Clowes & Sons, Ltd., Beccles, Suffolk. We shall assume that silence is equivalent to consent.

WAR

AFTER more than a year of anxiety and unrest Great Britain is at war. The struggle for the maintenance of stability and the recovery of Peace in Europe has begun. No one can foresee when it will end. As far as the peace-loving nations are concerned it must be fought to a finish. They must either defeat Germany out of all question and compel her to make terms which will preclude the resort to force of arms for the settlement of international differences, or submit to the will of a tyrannical power, or permit the perpetuation of the intolerable conditions which have prevailed since Herr Hitler adopted the policy of the mailed fist. There are no two ways about it. We must gird ourselves for a long and arduous war for only by resolutely facing the possibility of the worst can we fit ourselves to endure till the end. Consideration of Germany's ability to carry on a war for many months, of the possibility that her people may rebel against it, and of the means and forces that the allies can command to hasten and increase the difficulties of their enemies do not come within the province of this paper. All that the great industry which we represent can do is to obey orders and to strain every muscle to provide our forces on land and sea and in the air with the material they need.

We conceive ourselves to have a double duty as a technical and scientific journal. On the one hand we must support and encourage all those who belong to our profession and industry in the grave duty upon which they are engaged, and on the other we must endeavour to circulate amongst them information which may be of value in the prosecution of the war or which will help to maintain in some measure the engineering trade and enterprise of Great Britain. In these first few days of the terrible struggle the thoughts of the country are on the war itself. It is difficult to give calm attention to other matters. Quiet concentrated thought is almost impossible. At every hour we are listening anxiously to the broadcast news and at any moment of the day or night may have to shelter against air raids. But as the days wear on and we become habituated to the frequent disturbances, and when grievously depleted staffs are working smoothly under strange conditions, then we shall remember that the ordinary trades of this country must, to as great a degree as possible, be maintained. In 1914 the slogan was "Business as Usual." That was in part bravado, to show our enemies that war would not be allowed to disturb the tenor of British industry; and in part an avowal of the faith that the maintenance of industry was essential. That slogan would be vain and senseless to-day. Business cannot be as usual; but however unusual it may be it must be carried on in so far as it does not hamper or delay our military efforts. The war comes first, but after it and despite it, the ordinary affairs of the land must be considered. It is there that this paper and the whole scientific and technical press can perform an important duty. As in times of Peace it has sought to further the progress of industry and the expansion of knowledge so it must do in this time of war. Such a conflict as we have now entered upon must inevitably set back the movement of the whole civilised world towards the greater happiness and contentment of its people. It must delay, for we know not how long, the development of useful inventions, and the progress of those arts which increase the amenities of life. But we conceive it to be the duty of every one of us to see to it that all is not lost in the turmoil of war and to determine that, come what will, we will hold fast to some part of the civilisation which has been built up in the course of centuries not less by the pursuit of science and its application to industry than by philosophy and art. In that endeavour THE ENGINEER and its contemporaries can play no mean a part. Difficult as it may be, and we know not under what mental strain or personal grief, we and our contemporaries will do our utmost to serve the industry and profession to which we are devoted, to circulate knowledge useful to scientists and technologists, and to promote both the internal and external trade of our country.

The inconceivable has happened. One man, and one man alone, has put two hundred million persons in a state of war; one man and one alone has already set some four millions of men about the business of killing and maiming each other. By the operations of an appalling system he has secured complete mastery over nearly a hundred million men, women, and children. All liberty of thought and action has been denied them. For two years or more he has directed the Teutonic people to build up a vast fighting machine, and he has reduced them to a condition approaching slavery and nearing the verge of hunger if not starvation. He has done all that as the supreme representative of an ideology which we firmly believe is not freely accepted by the majority of German people. As we have said before we have no quarrel with the Germans. Our quarrel is with a system which we hold to be atrocious and outdated. How long Herr Hitler and his operatives can hold in thrall the will of millions of people no one can say. But of one thing we are convinced that sooner or later the nation will arise against tyranny and overthrow the tyrant. That day will be brought nearer by every step that is taken successfully to prove that force can be destroyed by force. In that the part that engineers have to play is a tremendous and awful one; but only by playing it with all their might and main can they hope to hasten the return of peace and tranquility to a harried world.

The Attitude towards Apprenticeship

MANY of the older readers of THE ENGINEER will recall the time when the only hope for the engineering graduate to obtain a post in industry lay in hiding the fact that he was the proud possessor of a degree, and emphasising the amount of practical experience he had gained. The works manager was essentially a practical man, with little or no respect for academic distinctions, and even to this day there remain many of the old school, men who have succeeded in holding their own by rule-of-thumb methods. Fortunately, there are not many as unenlightened as the head of a big engineering factory, who, when approached by his chief metallurgist for authority to purchase some apparatus, retorted that the works had been able to produce its goods twenty-five years ago without such aids to manufacture, and indeed that the metallurgist himself was an unnecessary luxury. This is an extreme case admittedly, but it is one that occurred within the past twelve months, and is mentioned as indicative of the fact that the old order dies slowly. Speaking generally, however, the pendulum eventually swung to the opposite direction, and it was recognised that our engineering colleges turned out well-educated and capable men, full of confidence and ready to attack any problem that came their way, but perhaps too unmindful of the old adage that "fools rush in where angels fear to tread." Engineering professors assured parents that after a course at their college the student would be fitted to obtain suitable employment and that all the practical training that was necessary could readily be acquired in the college workshop, ignoring the fact that the machine tools were often antiquated, the method of teaching deplorable, and the atmosphere of the commercial workshop conspicuous by its absence. Fortunately, a few engineering schools definitely stated in their prospectuses that in addition to the college course it was essential for students to obtain practical training in modern engineering works. To the credit of the Institution of Mechanical Engineers it should be stated that among the requirements for membership, apprenticeship or pupilage in recognised engineering works still takes an important place.

Having said so much we make bold to assert that modern requirements are so exacting that neither the wholly practical nor wholly academic man can hope to be a complete success in industry. It is essential to have both qualifications. A few weeks ago we drew attention to the new type of foreman now found in engineering works, and it is suggested that the logical sequel to this development will be that in the near future industrialists will insist on all their managers having held the post of shop foreman. This in turn brings us back once more to the necessity for a full apprenticeship. The attitude of the engineering student is very important, for unless he goes into his apprenticeship wholeheartedly, instead of merely regarding it as a necessary evil to be endured because certain institutions require it, he will be in sore danger of losing all the good of it. There is an increasing tendency for students in their last year at college to specialise in a particular branch, and they are prone then to

expect their apprenticeship to revolve round their specialised subject. This is an entirely erroneous outlook. While it is highly desirable to become a good craftsman, and to be able to operate modern machine tools efficiently, the greatest value of apprenticeship is to be found in its human side, in enabling the young engineer to view everything from the standpoint of the British workman, to appreciate his difficulties, to enter into his fear of discharge, to be enlightened as to his family budget, and to be permitted to know something of his home life. By understanding the views of the men he is destined one day to rule, he will develop that sympathetic feeling towards them that will enable him to surmount many a labour difficulty and avoid that friction which is frequently—indeed usually—avoidable. It is especially interesting to notice that France has discovered that the successful production engineer must have sound workshop training, and the result has been that the Minister of National Education has decided to create centres of instruction for engineers leaving the schools with degrees. These young men will be treated exactly the same as the workers, and will receive similar pay; they will be placed in suitably selected works. Such a scheme has in it the elements of success. Too often in this country preferential treatment is given to the apprentice—or pupil, as the young man prefers to call himself—and thereby he loses everything! He should be subjected to the same disciplinary action as the men, and he should share all their hardships and limitations, for by so doing he will greatly benefit and will be able in later years to ensure good working conditions for the men entrusted to his care.

Accordingly it is suggested that a changed outlook towards a full apprenticeship—and let no one be ashamed of the good old word—is highly desirable. Is it expecting too much to ask the engineering professor to impress on the parent that his son will be only partially educated when he leaves the university, and that the course in a commercial workshop is an equally important part of his training? Is it expecting too much to ask the student to regard apprenticeship as a privilege highly to be desired, as a period in his life to which he will look back in after years with happy recollections of experience gained in ways otherwise unobtainable? If the answer to these questions is that it is *not* too much to expect, and that the outlook suggested is a reasonable one, we feel confident that we may look forward to a better feeling between employer and employed, with improved management, and that those artificial barriers between the upper and lower strata of society in the engineering world will fade into insignificance.

Literature

The Essentials of Reinforced Concrete Design. By R. F. B. GRUNDY. London: Chapman and Hall, Ltd. 1939. Price 10s. 6d. net.

ALTHOUGH there have been no Government regulations in this country for the design and construction of reinforced concrete, authoritative guidance has never been lacking. The report of the joint committee appointed by the Royal Institute of British Architects, first published in 1907, held pride of place until 1915, when the London County Council made regulations. In 1934 appeared the report of the Reinforced Concrete Structures Committee of the Building Research Board of the Department of Scientific and Industrial Research, with recommendations for a Code of Practice for the Use of Reinforced Concrete in Buildings, and in 1937 the London County Council published new by-laws to be followed in 1938 by a Memorandum on the Computation of Stresses. Mr. Grundy has written his book on "The Essentials of Reinforced Concrete Design" with special reference to the last three of these four specifications, which are closely related, since each undoubtedly owes a good deal to its predecessors. He is following precedents established by Mr. E. S. Andrews, who, in 1921, published a handbook with explanatory notes on the old London County Council regulations, and by Mr. W. L. Scott and Dr. W. H. Glanville (two members of the drafting subcommittee), who published an explanatory handbook to the Code of Practice.

These well-known regulations and specifications for design are so complete in themselves, and give such detailed indications of the calculations required, that we may well ask if any further explanations are really necessary. One of the more abstruse sections of the Code of Practice is that dealing with slabs supported by columns, with or without drop panels, but no beams, and this section Mr. Grundy has decided is beyond the scope of his pages. We cannot recommend his work as an elementary text-book, as the presentation of the theory of bending, for example, is misleading, suggesting, as it does that the neutral axis of an unreinforced rectangular concrete beam would be situated at one-tenth of the total depth below the compression surface, because concrete is ten times as strong in compression as in tension. The neutral axis of the old cast iron beams and of the newer reinforced concrete beams is constrained to move in a convenient direction by altering the relative areas of the flanges in the one case and the proportion of reinforcement in the other. It cannot rationally be done by means of hypotheses which result in the modulus of elasticity of concrete in compression having one hundred times the corresponding value in tension. The interest of this volume lies, then, in the clearly tabulated comparisons between the provisions of the London County Council regulations, old and new, and those of the Code of Practice.

The sequence followed is not that of any of the official publications, and the first chapter is divided between working stresses and short columns. The principal change in working stresses is that the Code of Practice and the new London County Council by-laws allow a maximum tensile stress in steel of 18,000 lb. per square inch instead of 16,000 lb., and higher maximum compression stresses due to bending than the direct stress values for ordinary grade concrete mixes, and both figures may be still further increased for higher-grade concrete mixes. The old London County Council regulations introduced a modular ratio varying from 15 for a 1 : 2 : 4 mix to 12 for a 1 : 1 : 2 mix, and the Code of Practice raised these figures to 18 and 14 respectively. The new London County Council by-laws return to the old constant value of 15 for this ratio. The old London County Council regulations were very severe on columns. A cover of at least 1½in. was required for the longitudinal reinforcement, and only the area of the hooped core of concrete was considered, so that although with 2 per cent. or more of binding the permissible stress on this hooped core could be increased by as much as 33 per cent., this could never compensate for the area lost in columns of normal size. The Code of Practice and the new London County Council by-laws include the full area of concrete when ordinary laterals are used. The Code of Practice also allows a constant compression stress of 13,500 lb. per square inch in mild steel longitudinal reinforcement, irrespective of the stress in the surrounding concrete, but the old and new London County Council regulations limit this compression stress to that in the surrounding concrete multiplied by the modular ratio.

The conditions for long columns, considered in the subsequent chapter, are not easy to compare owing to different definitions of effective length and the different sections on which the radius of gyration is calculated. The author states that the maximum concrete stresses allowed in columns subject to bending moments are the higher or bending stress values, but the wording of the Code of Practice clause for columns subject to bending clearly indicates that the permissible direct stress value must not be exceeded. In the theory of bending applied to singly reinforced beams the author repeats the standard assumptions recognised that plane sections before bending remain so after bending, and that for any given steel and given quality of concrete the value of the modular ratio is a constant, which render his theory of the position of the neutral axis in an unreinforced concrete beam, on which we have already commented, untenable.

The design of slabs is considered in Chapter IV. The old London County Council regulations favoured Grashof and Rankine's values for the proportion of load carried in either direction of slabs supported on four sides, and left the designer to allow for the condition of the ends, simply supported, continuous or fixed. The Code of Practice and the new London County Council by-laws follow the same rule for simply supported slabs, but specify even more favourable conditions than the old French Government rules for simply supported slabs in which the corners are prevented from lifting and for slabs fixed at, or continuous over four sides. This chapter concludes with a useful table of bending moments, reactions, and maximum deflection in beams, with free or fixed ends, and in cantilevers, under many different arrangements of load. Similar characteristics for continuous beams over from two to six spans are given in the subsequent chapter on the design of beams and T beams, with single reinforcement, part compression reinforcement, and double reinforcement. In the latter case the steel resists all the compression stress. In the chapter on shear in beams illustrations are given of the lattice girder method of steel in tension and concrete in compression, authorised by the Code of Practice and the new London County Council by-laws, and in a short final chapter the author outlines the design of L-shaped and counterfort retaining walls.

This comparatively brief analysis of the London County Council regulations and Code of Practice, comprising 130 pages, seventy-one illustrations twenty-seven tables, twenty-four worked examples, and twenty-six exercises with answers, represents a vast amount of commendable work. In the tables of permissible column loads, for example, each contains details of the load carrying capacity of thirty-three different columns, under each of the three specifications.

BOOKS RECEIVED

Geology and Engineering. By R. F. Legget. London: McGraw Hill Publishing Co., Ltd., Aldwych House, W.C.2 Price 22s. 6d. net.

Rural Water Supply and Sanitation. By F. B. Wright, Ph.D. London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. Price 12s. 6d. net.

"Power Transmission" Trade Names Index and Directory, 1939–40. London: *Power Transmission,* 65, Chancery Lane, W.C.2. Price 2s. net.

The Factories Act, 1937. Second edition. By H. Samuels, M.A. London: Stevens and Sons, Ltd., 119, Chancery Lane, W.C.2. Price £1 10s. net.

Principles of Mechanism. Third Edition. By F. Dyson, A.S.C.I. London: Oxford University Press, Union House, Warwick Sq., E.C.4. Price 12s. net.

Semi-conductors and Metals. By A. H. Wilson, M.A. London: Cambridge University Press, Bentley House, 200, Euston Road N.W.1. Price 7s. 6d. net.

Handbook of Hydraulics. Third edition. By H. W. King. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 24s. net.

A Text-Book of Heat. By H. S. Allen, M.A., D.Sc., and R. S. Maxwell, M.A., B.Sc. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 10s. net.

Introduction to Contemporary Physics. Second edition. By K. K. Darrow, Ph.D. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 25s. net.

A Modern Marvel: The Harnessing of Light. By Col. the Hon. Arthur Murray, C.M.G. London: Electrical Press, Ltd., 60, Kingsway, W.C.2. Price 1s. 6d. net.

Factory Lay-out, Planning, and Progress. Second Edition. By James Stirling. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, W.C.2. Price 7s. 6d. net.

Heating and Air Conditioning. Fifth Edition. By J. R. Allen and J. H. Walker. London: McGraw Hill Publishing Co., Ltd., Aldwych House, W.C.2. Price 25s. net.

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The British Association

No. I

IN spite of the international tension, the meetings of the British Association started according to programme in Dundee on Wednesday, August 30th, when the President, Sir Albert Seward, F.R.S., delivered his Presidential Address on "The Western Isles Through the Mists of Ages." The attendance this year was well over 3000, the highest for some years, and the local membership was also the highest that has been recorded for a long time.

SECTION G.—ENGINEERING

The sectional meetings opened on Thursday morning, August 31st, and in Section G, Mr. H. E. Wimperis read his Presidential Address on "The Future of Flying," which is reprinted in the present number.

UNIVERSITY ENGINEERING COURSES

The first paper was on "University Engineering Courses," by Professor Willis Jackson, of the Electro-Technical Laboratories of the University of Manchester. Following Professor Southwell's Presidential Address to Section G last year, in which he stressed that undergraduate courses in engineering science were in danger of becoming overcrowded and unduly specialised to the detriment of their educational value, the Sectional Committee decided to implement his suggestion that the opinion of industrialists should be sought by undertaking an informal inquiry on the matter. This inquiry was left in the hands of a small Committee, through which approaches have been made to about fifty industrial and other concerns—civil, mechanical, and electrical engineering—both through visits, where possible, for the purpose of discussion, and by means of two questionnaires. One of these questionnaires was addressed to those responsible for either recruiting or supervising the work of university engineering graduates, and the other to the graduates themselves.

The paper did not give a full statement of the objective analysis of the replies, which is to be considered first by the Sectional Committee, but rather concentrated on the salient points, Professor Willis Jackson himself not expressing any personal opinions. Thanks were expressed to all those, firms and others, who had given assistance. The total number of completed questionnaires received was about 650, which, whilst admittedly covering only a fraction of those whose point of view would have been valuable, constituted a considerable body of opinion. The inquiry concerned itself only with the university course, and not with the necessary supplementary provisions for industrial training and for continued technical education. That was done, not because it was felt that the two were in any sense independent, but because it was felt that consideration of the latter, and a decision as to its nature, would follow more or less automatically from a definition of the precise function in the combined scheme of the university course, of its desirable scope and content, and of its present deficiencies. Professor Willis Jackson said it was gratifying to those in the universities who were concerned with the preparation of young men for entry into the engineering industry that, much as industrialists might be inclined to criticise the products of university courses, they nevertheless found them to possess, on the average, greater potentialities than those who received their technical instruction in part-time evening classes, whilst there was no evidence whatever that the graduates themselves, though in some cases they were extremely critical, regarded their attendance at a university as having been other than a considerable advantage.

In the opinion of the large majority of those responsible for supervising the work of university graduates, they possessed on the average a sounder knowledge of fundamental scientific and engineering principles and, in consequence, approached new problems in a more satisfactory manner, absorbed new ideas and specialised knowledge with greater ease, were generally more adaptable, and required less guidance and supervision than men of non-university education. On the other hand, they tended to compare unfavourably with the men on the more practical and production sides of the industry, partly owing to their more restricted practical training, but also to their reluctance in many cases to undertake arduous and routine labour as a means of gaining necessary experience, and to the fact that their expectation of reward frequently exceeded their willingness to justify it by persistent endeavour. It was evident, both during discussion and from the replies, that those responsible for recruiting university graduates attached only a limited significance to the university's assessment of a man's ability as expressed by the class of degree awarded.

Regarding the content of the university course, a considerable majority of the replies from industry were definitely against the idea of specialisation within one of the main branches of engineering at the university, and were in favour of keeping the course on the broadest possible lines. At the same time, many of those who spoke against specialisation emphasised the danger of university courses becoming too academic in outlook.

The graduates, on the question of specialisation, considered, in the main, a division into civil, mechanical, and electrical groups as essential during the later stages of the course, and some of the subjects of specialisation mentioned were electrical machine design, electric traction, electrical communications, heat engines, highway engineering, and oil technology. Less than 20 per cent. considered that the degree course was overcrowded, although there were complaints that too little time was available for independent reading. Views were also expressed that too much time was devoted to drawing office and machine design work which had little relationship to industrial practice; that too much of the laboratory work had little thought value and was largely unprofitable; that for electrical engineers the amount of attention given to surveying, hydraulics, and heat engines might be reduced; that workshop courses should be eliminated; that much of the first year course was no more than a repetition of what had already been covered at school; and that much effort was wasted through unsatisfactory co-operation between the lecturers in the various subjects.

The paper also dealt in a little detail with some of the other replies on specific points, and it was pointed out that possibly because an expression of opinion was not asked for, the question of the relative merits of the sandwich system and the more normal arrangement in which the period of industrial apprenticeship training is delayed until after the completion of the course, and that of whether the university course should be of three or four years duration, were not widely raised, but in view of their importance, Professor Willis Jackson said it was hoped to make them the subjects of a supplementary inquiry.

DISCUSSION

Dr. A. T. Bowden (Perth University, Western Australia), said that in recent years the details of the courses at Perth University had been cut down to the bare minimum and they were hoping in that way to turn out reasonably intelligent engineers. There was a five years course, worked on the sandwich system, and specialisation began in the fourth year. During the whole course, the students had some two years practical experience, and things were so arranged that they had time to develop cultural subjects, although there was no examination in them. In the fifth year the students could please themselves what they did. They might prefer to take lectures or to go outside the university altogether and carry out selected work which the university approved, or they could conduct specialised work within the university. It had been found that that plan turned out men who were perhaps not experts in any one single branch, but had general intelligence and a certain cultural background, whilst some knowledge of how to deal with men was gained during their two years practical work.

Continuing, he said that Professor Burstall had recently taken up the Professorship of Engineering in Melbourne, and had instituted a three years course, which, however, was meeting with a great deal of criticism in Australia. It was instituted because Australia was becoming a largely industrialised country, and Professor Burstall's idea was to give his students a fair fundamental knowledge of engineering and to allow those who specialised to come back to the university for that purpose. The ordinary three-year man would go out and find his own niche in industry. The scheme had been working for two years, and the results of it could not yet be assessed, but there were many who felt that it was a retrograde step, and he personally preferred his own five years course, with two years practical experience. At all events, it fitted in with the needs of Western Australia. Nevertheless he was looking forward with great interest to the results obtained by Professor Burstall.

Prof. R. V. Southwell, F.R.S. (Oxford), remarked that another result of his own Presidential Address last year was that the Institution of Civil Engineers had organised a three days' conference on this subject, to take place next February. At that conference the employers would be invited to say what they wanted, and he presumed the Professors would be invited to reply and to say that the employers could not have it! At all events, there would be a sort of three days jamboree. Personally he felt that it was necessary to bring a new outlook to bear on the question of engineering education. The work should be shared by the universities and industrialists, and could not be done by the universities alone. His own ideas were developing in the direction of lightening the syllabus, because the first need of industry was for what might be called Subalterns, good all-round men with plenty of personality and side interests. As regards specialisation, in a three years course he would not have boundaries between the different branches of engineering, because they could only be artificial. For instance, the technique of modern vibration theory was almost exactly the same as the technique of A.C. engineering, and the two subjects should be treated for their similarity. Therefore, he would prefer three years entirely non-specialised, in which general principles were taught for their own interest and to stimulate imagination, after which the students should go into industry for practical training, and then go back to the university for some training in law, industrial organisation, &c.

Professor A. R. Fulton (Dundee University) referred to the three years courses in Dundee and Glasgow, and commented on their strenuous nature, which, he said, left the students very little time for cultural or sporting pursuits. The second of the three years was essentially engineering. The aim was to have a general education in engineering, rather than a specialised education, and in the second year all the students took the same course. In the third year there were individual lectures on civil, mechanical, and electrical engineering subjects, and the practice had grown up for the electrical man, for example, to take an extra year to study mechanical engineering, and the mechanical man to study electrical engineering, as the case might be. The whole object was to give a thorough ground-work in the fundamental principles, to enable the students to put those principles into operation when they had to face actual problems in industry later on.

The President, commenting on the reference in the paper to the second-class Honours candidate, said that when he was recruiting men for research work for the Air Ministry, as he did for a number of years, he did not choose only those who had obtained first-class degrees. He always asked for first- or second-class degree men, not because he did not want first-class degree men, but because he did not trust the universities always to distinguish between the two. It was for that reason that he gave an equal chance to the second-class men to present themselves. He wanted qualities other than those revealed by examination. He wanted qualities of leadership, and when a man had been President or Chairman of some undergraduate or student activity, that was always a great recommendation. He agreed with Professor Southwell that the purpose of university training should be to teach first principles, for it was impossible to foretell in what direction a student might specialise later on.

Mr. W. T. MacCall (Sunderland) asked what period of the five years under the Perth University scheme was spent in the works.

Dr. A. T. Bowden said that it varied.

Mr. MacCall, continuing, said that there were differing opinions as to the application of sandwich schemes, and information on that matter from other sources would be valuable. Should the period in the works be a year or more, or shorter? His own scheme provided for six months in college and then six months in the works, but that was not now applied to the degree students. Finally, he asked Professor Southwell whether his view, that in a three years course there should not even be a division between electrical, mechanical, and civil engineering, would apply to those students who, at the completion of the course, had had one year or more works experience? In his own case, all the students, with very few exceptions, had

eighteen months in the works before they started on the degree course, and it seemed to him that by the time they reached the third year of the ordinary course, a certain amount of specialisation, to the extent of separating mechanical, civil, or electrical engineering, was advisable.

Professor Southwell said he had not been thinking so much of the courses as they were to-day, but as to how they might be planned for twenty years ahead. If there was a merging of responsibility between the universities and industry, he was hoping it might be possible to arrange something which would have the advantages, without the disadvantages, of the sandwich system. The average young man did not know, until a late stage in his career, what he wanted to do, and the best men did not specialise early. By going to a works before going to a university, a man artificially, so to speak, put himself in a specialised class earlier than was desirable in his own interests. If he could go out into industry after three years in the university, and then go back to the university, it seemed to him that that would be ideal, but he was not suggesting that such a scheme should be introduced now or even next year.

A speaker, representing the Engineering Sub-Committee of the National Union of Students, which was formed eighteen months ago to discuss problems peculiar to engineering students, said the paper covered the subject matter of the discussions of the Union, and all the findings of the Union were in complete agreement with the paper. On the question of the ideal engineering course, he said the Union had decided quite conclusively that it would like to see students going into industry for a period of six or twelve months before entering the university. In that way they would have an opportunity of appreciating responsibility and of developing their characters, with the idea of becoming specialists, and with that experience they would appreciate more fully the university course later on. The difficulty, however, was to publicise such an idea. The Union had circulated it to the universities, who had replied that it was at too early a stage now to introduce it, and the Headmasters' Association, which had also been approached, had referred the Union back to the universities. In these circumstances, he said, the Union was gratified that this paper had been presented, and gave it full support.

Mr. D. B. M'Lay (City Engineer, Dundee) agreed with the views expressed by Professor Southwell and the President that a university course should be on the broadest possible basis. Up to the third year all students should take the same course, because such subjects as the strength of materials, mechanics, mathematics, and physics applied to every branch of engineering, and the broader the basis of instruction in such subjects in the university course the better for the students in later life. His own personal experience was that the engineering student suffered under a very great disadvantage compared with the arts student or the medical student, for the engineering course was so full that there was no time for sport or cultural pursuits. Yet these latter were of great importance and it was a matter of great regret that, owing to the nature of his training in engineering, the engineering student was quite unable to take any part in the cultural side of university life. Commenting on the suggestion that outside engineers should lecture to students in the universities, he said that that was actually being done in Dundee and Glasgow, and no doubt elsewhere, through the medium of the engineering societies which the students were encouraged to join.

The Author, in a brief reply to the discussion, said he had not obtained any opinions as to the advantages of the three years versus the four years course, but from his own observations he rather gathered that where the course was four years, the fourth year tended to degenerate into a specialised course within the particular branch of engineering. He knew of one case in which, on the electrical side, it was possible for a student to drop all mechanical engineering subjects and take up the specialised study of electrical machine design, electrical measurement, electric traction, electrical communications, or high voltage work, but that was quite contrary to anything that he personally would tolerate, and he believed his was a wide-spread view. Whilst agreeing that the syllabus should be reduced to permit time for other things, he felt that there was difficulty in doing so. As to outside engineers lecturing to students, most universities had their engineering societies and had outside lecturers, but a point often raised was that that was not sufficient and that outside lecturers ought to form an integral part of the course. At the same time, it was difficult to find the right men for that work.

The Flow of Liquids Through Beds of Granular Solids

The only other paper presented in the morning of August 31st was on "The Flow of Liquids Through Beds of Granular Solids," by Mr. W. H. Ward, who pointed out that its practical application lay in such fields as irrigation, drainage, water supply, seepage around dams, oil production, and in the ceramic and chemical industries. Until quite recently, he said, the design of earth dams, dykes, and underground water supply schemes was based almost exclusively on empirical knowledge; but, with the development of modern soil mechanics and the understanding of seepage flow, a far more scientific approach was being made to the design of earth-water structures.

In a consideration of the subject, which was largely theoretical, he said it was mathematically impossible to apply the Navier-Stokes equations to the flow of fluid through beds of granular solids, owing to the extremely chaotic microscopic structure of the boundaries. Macroscopically, for small velocities, the velocity was directly proportional to the pressure gradient and the coefficient of permeability (d'Arcy's law). At high velocities, the square law held, and at intermediate velocities, where the inertial forces were still important, a plot of friction coefficient (C_f) against Reynolds' No. (R) showed a long smooth transition curve. From flow tests on numerous samples of unconsolidated sands and gravels, it was possible to group together the CR curves into a narrow band. Visual experiments' using fine coloured jets, threw some light on the nature of the type of flow occurring.

By applying the equation arrived at in the above-named manner to the cases of radial and radial gravity inertial flows in a tube well, equations for the pressure distribution could be developed. Observations made on a model well with inertial flows had been found to be in close agreement with the theoretical solution. Such inertial flows must occur in practice in the region immediately adjacent to a well which was being pumped rapidly.

Abandonment of Meeting

On Friday afternoon, September 1st, after the various Sectional Meetings had been completed in the morning and some which were to continue in the afternoon had been abandoned, the General Committee of the Association met and decided that in view of the serious turn in the International situation it had no alternative but to abandon the meeting as a whole.

The Committee elected Sir Richard Gregory, Bart., F.R.S., as President for next year and an invitation to hold the meeting in Newcastle-on-Tyne in 1940 was accepted. The provisional date of the meeting is September 4th–11th.

(To be continued)

Oil-Engined Locomotives for Gassy Mines

Oil-Engined locomotives have been used in coal mines on the Continent for many years, with no apparent lack of safety, under rules developed by the German, Belgian, and French Mines Departments. In this country, the oil-engined locomotive for mines use is just arriving. The lag is due partly to the need for assurance on the safety aspect, and partly to a feeling that this form of traction might not be economically suited to British colliery roads and needs, especially to the gradients encountered.

In addition to mines use, the oil-engined locomotive has definite advantages in dangerous situations, such as in the vicinity of inflammable and explosive materials. The Hunslet Engine Co., Ltd., of Leeds, has for some years supplied such locomotives for this purpose, one of the earliest being an 80 H.P. locomotive supplied to Woolwich Arsenal for use near magazines; it was chosen having in mind the intrinsic safety of the oil-engined locomotive, and was not provided with protective devices. Later locomotives supplied for similar purposes had simple spark arresters of the centrifugal type.

Meanwhile, the Hunslet Engine Company, Ltd., was carrying out experiments regarding the more definite safeguarding of the exhaust, both from the point of view of any possible ignition of an inflammable atmosphere, and with regard to the chemical analysis of the exhaust gases, when used in enclosed spaces and underground. After much research work, the firm developed an exhaust gas conditioner and spark and flame arrester which was fitted to many locomotives for arsenal and similar purposes. Locomotives were also supplied for use in metalliferous mines. An illustrated description of the apparatus was published in these columns on October 29th, 1937.

Considerable interest is now being shown in the oil-engined locomotive by British collieries, for under suitable conditions it is much quicker than rope haulage, having a speed of 12–15 m.p.h., and being capable of hauling against gradients of 1 in 12. Such haulage is self-contained, and locomotives can be used either for main haulage or for feeding. Compared with rope haulage and the electric-battery locomotive, the oil-engined locomotive is claimed to be less expensive both in initial and maintenance costs, and it can haul a load at comparatively high speed under complete control of the driver, with full safety precautions.

When the firm was approached by various colliery companies regarding the use and design of diesel engines for gassy coal mines, it took up the matter with the Mines Department and discussions took place regarding the type and severity of testing to which locomotives should be subjected. The method of test was based upon the assumptions "that although it could be argued that flame could not pass out from the final exhaust through the conditioner and that similar statements could be made with regard to the inlet air filter, yet if by some conceivable chance flame was formed in either the inlet manifold, or exhaust manifold, and if at the same time the atmosphere

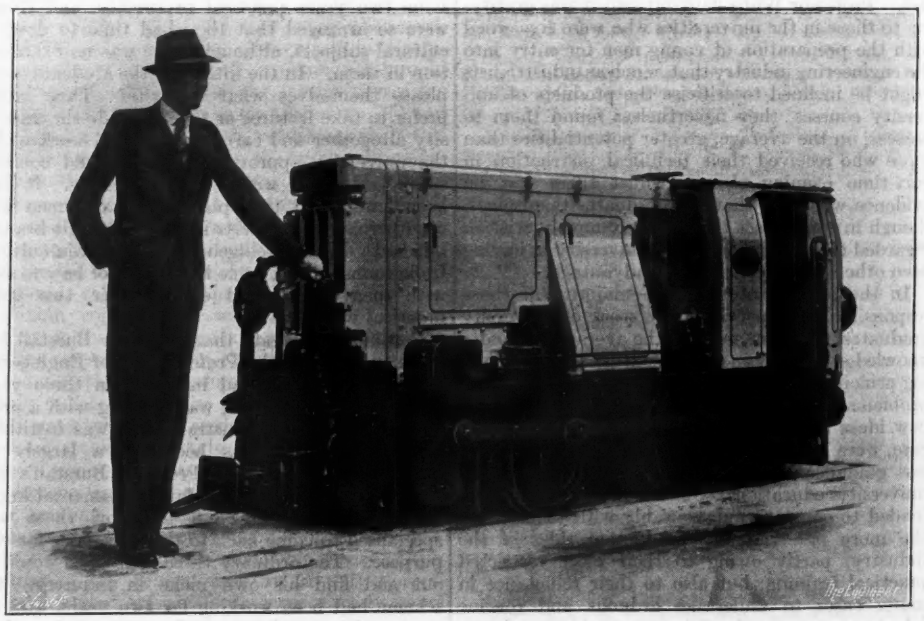


FIG. 1—25 H.P. MINES LOCOMOTIVE

in those manifolds happened to be of a highly explosive nature, then a severe explosion would occur, causing a high pressure and propagating flame outwards from the engine towards the inlet and outlet apertures respectively, and that the equipment had to be so manufactured that should the above take place no flame of any kind could pass to the outside atmosphere."

This assumption, of course, meant that the whole of the cylinder head design, including cylinder head joint, injector joints, valve stems, valve covers, manifold joints and all joints throughout the inlet and exhaust systems must be fully flameproof in accordance with existing regulations for flameproof electrical equipment and that both the inlet and exhaust orifices must be of a type which would definitely stop the most penetrating type of flame and that furthermore all these parts would have to undergo test at Buxton to prove that they were capable of withstanding such flame.

The firm then set about manufacturing equipment of this type and in May, 1938, complete equipment, including a specially designed exhaust gas conditioner and flameproof grille, was accepted for test by the Mines Department and despatched to Buxton. The tests were, we are informed, in every way satisfactory.

Since that time progress has been rapid and many

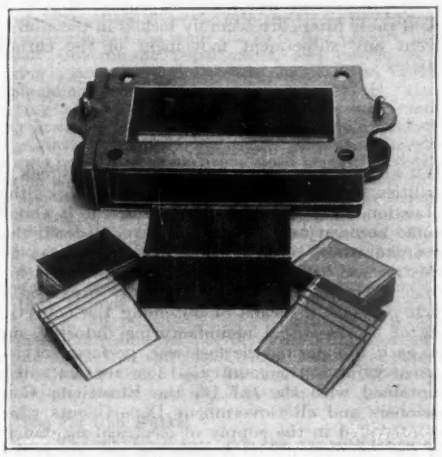


FIG. 2—PARTS OF FLAME ARRESTER

larger sets have been placed under construction. The Hunslet Engine Company, Ltd., is now building several locomotives, varying in size from 20 H.P. up to 100 H.P. with fully flameproof equipment of this type, but in order to meet Mines Department requirements every different size and type of locomotive, however slight the modification may be from the previous one, must be fully approved and re-tested at Buxton.

MINES TYPE OIL-ENGINED LOCOMOTIVES

We describe below a locomotive specially designed and produced for colliery work by the Hunslet Engine Company, Ltd., which is not only acceptable for use in British coal mines, but which is already in such service. The design is based upon main-line locomotive practice and the result is claimed to be probably the smallest locomotive in the world to such a specification. A general view of the locomotive is reproduced in Fig. 1.

In this locomotive a Gardner engine was considered to be very suitable for mine working. Special arrangements had to be made to make the heads flameproof in accordance with Mines Department requirements, and the whole of the inlet and exhaust equipment had to be specially designed and approved. On the inlet side the air is passed through an efficient air cleaner before meeting the flame arrester, shown in Fig. 2. All details of this flame arrester, including body and cap, cover plates, and the flame plates themselves, are manufactured in austenitic stainless steel and the unit is interchangeable with the exhaust flame arresters.

On the exhaust side the gases first pass through a non-return valve into the exhaust gas conditioner, whence the gases pass through flame arresters into an air mixing chamber where they are mixed with 30 or 40 times their volume of fresh air before being exhausted into the ventilating current.

Many refinements have now been made in this apparatus. The whole of the conditioner, cover plates, internal baffles, and all details, are manufactured in a suitable austenitic stainless steel in order to resist the highly corrosive nature of the water in the conditioner. Furthermore, automatic equipment has been fitted so that in the event of the water level being allowed to fall below a certain level, the fuel is automatically cut off from the engine and at the same time the locomotive and train brakes are automatically applied. This device does not, of course, function providing the maintenance staff have filled the conditioner with water at the beginning of every shift, but it is considered to be an essential feature.

We are informed by the firm that water, as proved in Continental practice, has been found to be the best and most economical exhaust cleanser. During the last few years many types of chemical and filtering materials have been tried and although many work satisfactorily for a short period they all require very frequent cleaning or changing, with the result that they are either left to work inefficiently or in many cases have been omitted altogether by the maintenance staff. As it has been found impracticable to arrange automatic shut-off gear when these materials have been omitted, the result has been a highly objectionable smell in the roadways which could not be tolerated, quite apart from the fact that it is not permitted under present regulations.

During the development stages considerable difficulty was caused by the exhaust flame arresters clogging and creating back pressure on the engine; this action took place within an hour of the engine being started up. Development of the internal design of the conditioner and the method in which the exhaust was made to enter the flame arresters has, however, overcome these troubles and to-day the routine arrangement is to change the arresters on the exhaust side every shift. Complete spare arresters are supplied with the locomotive for this purpose, so that the dirty ones can be cleaned during the following shift; this operation is claimed to be quite easy, since the design permits the plates to be separated and wiped clean in a simple manner, while the plates are so designed that they can be re-assembled without any possibility of their being misplaced.

The whole mechanical design of the locomotive is remarkable in that complete equipment on every type is carried within a height of 5ft. and a width of 3ft. 4in., this width corresponding to a 2ft. rail gauge, although in actual fact the locomotive has been designed so that it may be built at some future time to 18in. rail gauge, when the overall width will be 2ft. 10in. Already this particular unit has been built to rail gauges of 2ft., 2ft. 3½in., and 2ft. 6in.

The main clutch is the firm's single plate type, operated by air. The gearbox is of steel throughout, split on every centre-line, in accordance with the firm's main-line practice; the four-speed reverse and final reduction are embodied in a single unit. The speed changes are operated by a pre-selective automatic gear change mechanism, which is coupled with the main clutch and throttle in such a way as to give perfect gear changes through a single lever control, operated with a minimum of physical effort by the driver. This arrangement enables the driver to make gear changes without taking his eyes off the roadway and also allows the other hand to be continuously on the brake control, which is, of course, a power brake and can give a graduated or emergency application to both the locomotive and the train.

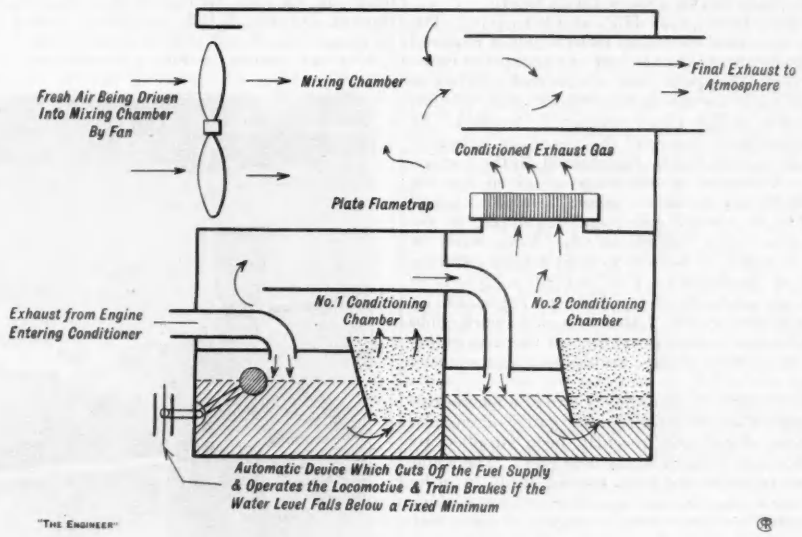

Fresh Air Being Driven Into Mixing Chamber By Fan
Mixing Chamber
Final Exhaust to Atmosphere
Conditioned Exhaust Gas
Plate Flametrap
No.1 Conditioning Chamber
No.2 Conditioning Chamber
Exhaust from Engine Entering Conditioner
Automatic Device Which Cuts Off the Fuel Supply & Operates the Locomotive & Train Brakes if the Water Level Falls Below a Fixed Minimum
"THE ENGINEER"

FIG. 3—EXHAUST GAS CONDITIONER

Compressed air is obtained by means of a two-stage air compressor, belt driven from the main engine, which has been specially designed to obtain a large volume of air from a machine which would take up very little room.

Although a hand brake is fitted, the service braking control is by compressed air; the control is coupled to the whole train set, so that every carriage is fitted with power brake equipment operated by the locomotive driver. This equipment is stated to be essential if full advantage is to be obtained from oil-engined traction underground, as without it high speeds are not practicable or safe down steep inclines. Furthermore, an emergency braking device is provided, consisting of a separate pipe-line under pressure from the locomotive down the train, inter-coupled in such a way that should a breakaway occur all brakes in both

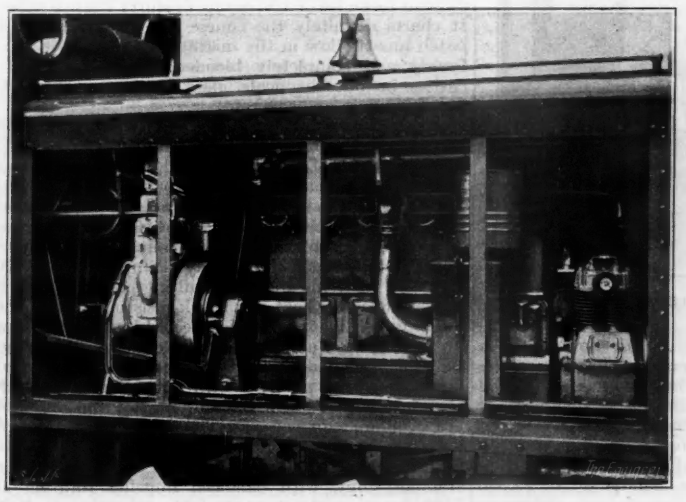


FIG. 4—115 B.H.P. NATIONAL OIL ENGINE

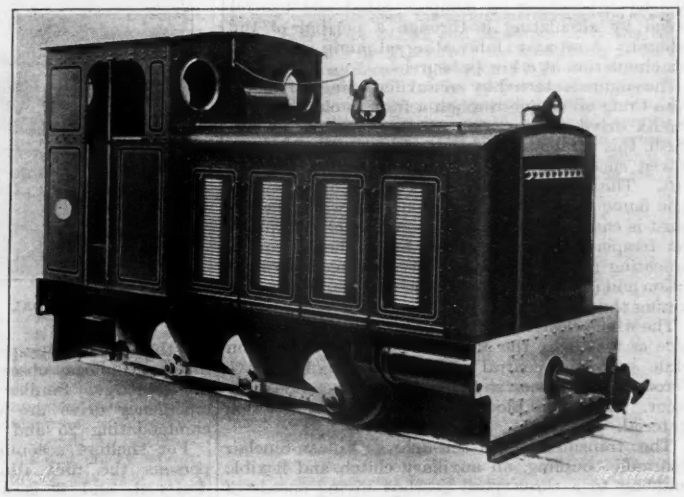


FIG. 5—LOCOMOTIVE FOR AN OIL REFINERY

sections of the train are immediately applied automatically, the brake on the locomotive also being applied in the same way.

The design of the running gear is substantial. A heavy jackshaft mounted in roller bearings within the gearbox transmits the drive to the wheels by grease lubricated coupling rods. Wheel centres are of cast steel with high tensile locomotive tyres shrunk on, as in main-line practice. Roller bearing axleboxes are fitted which are carried in forged steel boxes with phosphor bronze side liners in contact with cast steel horn guides.

The radiator is of all-steel construction, fitted with interchangeable sectional elements.

The electric lighting equipment is of interest. In view of the high speeds at which these locomotives are capable of running it was considered essential to have a first-class headlight. Therefore a special 60 watt unit was designed and tested at Buxton, for no powerful flameproof headlight could be obtained. As batteries were considered impracticable, dynamo lighting was decided upon; but again no suitable machine could be obtained and a dynamo had to be specially designed and submitted to Buxton for test. Difficulty was even experienced with the conduit, and special fittings had to be designed and manufactured before the whole lighting set was finally passed at Buxton as a complete assembly. Whichever way the locomotive is travelling, a powerful beam can be thrown a distance of several hundred yards, so that high speeds can be obtained with safety.

The engine develops 25 H.P. at 1300 r.p.m. The four gears give road speeds up to 15 m.p.h. if required and can be so arranged as to suit any particular roadway. It often happens that a standard gearbox is quite unsuitable for the inclines which exist, so that the available engine power cannot be utilised. In these locomotives, however, the gears are arranged so that high speeds can be maintained on the various sections. A typical speed range is given by the makers as 3½ m.p.h. on low gear; 5 m.p.h. on 2nd gear; 8½ m.p.h. on 3rd gear; and 12½ m.p.h. on top gear. Under such conditions the locomotive in question is stated to be able to haul a train carrying 100 men up gradients of 1 in 20; up to speeds of 8½ m.p.h. up gradients of 1 in 100; or 12½ m.p.h. up gradients up to 1 in 200. All down-grade work could be carried out at speed, providing all the man-riding cars were fitted with straight air brakes and emergency air brakes.

In Figs. 4 and 5 we reproduce views of a locomotive forming part of an order for four 3ft. gauge oil-engined locomotives which have recently been supplied by the firm to an oil refinery in the near east. The whole design has received the most careful study in order to make the locomotive safe in every way for working in an atmosphere which may be highly charged with pentane and other gas, to an extent that may render it highly explosive. The engine inlet and exhaust are protected by flameproof grids, of the pattern fully tested by the Mines Department and described above, and the gases before escaping pass through an exhaust gas conditioner.

In this locomotive the power unit is a six-cylinder oil engine manufactured by the National Gas and Oil Engine Company, Ltd., of Ashton-under-Lyne. When running at 850 r.p.m. it has an output of 115 B.H.P. constant rating and 127 B.H.P. maximum rating at normal altitude and temperature and is capable of delivering 96 B.H.P. constant rating and 106 B.H.P. maximum rating, under the conditions present at the site. Detachable cylinder heads are designed so that a high degree of turbulence is obtained, ensuring good combustion at all loads and speeds. Valves are removable without disturbing the heads or breaking any pipe joints. Non-choking atomisers prevent damage to the fuel system. A variable speed governor allows the speed of the engine to be controlled between the limits of 300 and 850 r.p.m. Special precautions have been taken to maintain the efficient working of the engine in the dusty tropical atmosphere. In addition to the usual Vokes air filter, all working parts are protected from the ingress of dust. A large capacity lubricating oil sump is fitted and the oil cooled by circulating it through a portion of the radiator. A separate lubricating oil pump maintains this circulation at a low pressure.

The engine is started by an auxiliary single cylinder Ailsa Craig oil engine through a friction clutch and a Bendix drive on to a ring on the main engine flywheel, this arrangement being of the type which has proved successful on the firm's locomotives in the past. This engine is also protected by an approved type flame trap on the induction side, while the exhaust is carried into the main conditioner. Exhaust gas temperature is measured by a thermo-couple indicating pyrometer, which gives an accurate indication and is of help to the engineer in charge in maintaining the oil engine.

The whole electrical equipment is also of flameproof type as tested by the Mines Department at Buxton while even the central couplers and buffers have Ferodo covered faces, so that no sparking can possibly occur. The brake blocks are also of Ferodo friction material.

The transmission is through a Vulcan-Sinclair hydraulic coupling, an auxiliary clutch and flexible coupling to a three-speed gearbox giving speeds of 3·4, 6·8, and 10·2 m.p.h. in either direction. The locomotive is able to exert a tractive effort of 9,930 lb., the adhesion weight of about 22 tons giving a factor of adhesion of nearly 5 to 1. The gearbox is constructed of steel plates and by the employment of stiff shafts, carefully designed gear wheels and ball and roller bearings throughout, high efficiencies of transmission are claimed. A pre-selective gear change controls the gears, eliminating the human element, a single hand-wheel not only speeding up the engine but also controlling the gears through a series of cam-operated pneumatic valves, which deliver air at a pressure of 50 lb. per square inch to the cylinders controlling the gears, clutch and clutch shaft brakes in their correct sequence of operation. The control wheels and all other locomotive controls are duplicated on both sides of the cab.

Westinghouse straight air brakes are fitted and are controlled by a self-lapping type of driver's brake valve in the cab. A Broom and Wade compressor supplies air for the brake and gear change mechanism.

The diameter of the coupled wheels is 2ft. 9in.; the wheelbase 7ft.; the overall height 9ft. 7in. and width 7ft. 9in.; and the length over the buffers is 18ft. 9in.

A.R.P. Fans

A NUMBER of simple and compact ventilation and gas filtration units for A.R.P. shelters are now being made by Vacuum Refrigeration, Ltd., 39, Finsbury Square, London, E.C.2, and the company has sent us particulars of two typical installations.

The unit shown in Fig. 1 is designed to handle

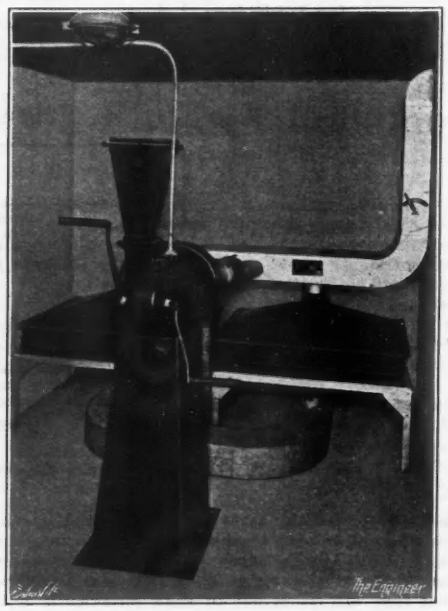


FIG. 1—HAND OR ELECTRIC FAN

15,000 cubic feet of air per hour against a 4½in. w.g., and is suitable for shelters holding up to 100 persons. It comprises a steel-cased centrifugal fan directly coupled to ½H.P. electric motor wound for standard voltages. One end of the motor shaft is coupled to an emergency drive in the form of two handles operating through a step-up gear. An air flow meter is fitted within easy observation of the operator on the fan discharge. Similar units having a single handle emergency drive are also made for shelters accommodating 25 and 50 persons.

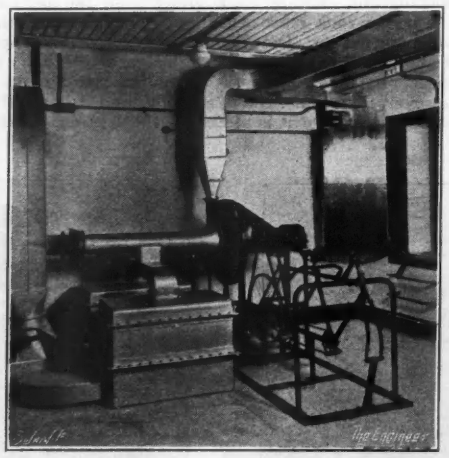


FIG. 2—PEDAL OR ELECTRIC FAN

For shelters accommodating from 100 to 150 persons the unit illustrated in Fig. 2 has been designed, and it is able to handle up to 22,500 cubic feet per hour of air against a resistance of 7in. w.g. The fan consists of a strong sheet steel casing stiffened with steel angles and the runner has double flange anchorings on both sides of the blades which are firmly secured to a mild steel hub. The fan runner is keyed to a steel shaft, and accurately balanced, the whole running in a double ball bearing housing attached to the fan casing.

In addition to the electric drive, this unit incorporates emergency pedal drive, in the form of a tandem cycle frame fitted with two saddles and having the usual driving pedals, chains, &c. Final drive between the cycle and fan is by a rubber belt, the tension of which is maintained by a jockey pulley. By means of a clutch the motor is disengaged from the fan before the emergency drive is brought into operation.

A flap damper to control the air output is fitted on the air discharge of the fan, and is calibrated on the outside for setting the air quantity relative to the number of people in the shelter.

The fans are used in conjunction with filters for the elimination of dust, arsenes and volatile war gases. Three separate filters are firmly secured under pressure in a strong tinned casing, and supported on a rigid frame of welded steel angles. Activated carbon and a mixture of merino wool and asbestos form the chief ingredients of the filters; both of these are to official analysis and are specially packed to ensure that no leakage is possible past the edges of each filter. Special precautions are taken to ensure that once packed these filters are securely locked in position to prevent any subsequent movement of the carbon particles.

B.E.A.M.A.

WE are informed that following the outbreak of hostilities, the B.E.A.M.A. will carry on its work either in London or from some other centre if it should become necessary or if it should be considered that the organisation could be of greater service to the Industry and the Government by making such a change. The B.E.A.M.A. is the only organisation which provides a means of obtaining the collective view of the electrical manufacturing industry, and can, as it did during the last war, perform services of great value to the country. Close contact will be maintained with the C.E.B., the Electricity Commissioners and all Government Departments which are interested in the supply of electrical machinery, and the members of the Association are prepared to assist the national effort in any way that lies in their power.

Chemical Industries Exposition, New York

THE Seventeenth Exposition of Chemical Industries is to be held in New York during the week of December 4th to 9th, 1939.

Chemicals and chemical raw materials will naturally constitute an important section of the Exposition, but there will also be much of interest to engineers.

Containers and packaging machinery are likely to be unusually well represented this year. A new type ampoule-sealing machine, never previously exhibited, will demonstrate its ability to handle with accuracy any of the numerous types of solutions which are dispensed to the public in ampoule form. Among the packaging equipment on display will be a low-priced cellophane bag-making machine. This unit is guaranteed to manufacture bags out of cellophane or similar materials in any size, single or double wall, printed or plain. Plant equipment designed for carrying out all the unit processes of chemical engineering efficiently and economically will constitute a large section of the Exposition. The display will include electro-magnetic vibrators, vibratory feeder conveyors, volumetric feeder machines, and weigh feeder machine equipment. A counter current rapid batch mixer contains a mechanical method for scientifically blending, mixing, and compounding difficult formulas of dry, damp, or slurry consistencies. It charts definitely the course the ingredients of a batch must follow in the mixing enclosure until uniformly and completely blended. Industrial applications include chemicals, glass, ceramics, abrasives, foundry sands, and concrete.

Among the pump exhibits this year, there will be a new kind of pump offering, it is claimed, the mechanical advantages of metal combined with the chemical advantages of glass. This pump will be shown to combat the effects of corrosive acids and chemical fluids which quickly destroy metal pipes and pumps. Also eliminated are the effects of minute traces of corrosion impurities which may completely change chemical reactions and the resulting product. Made of glass which is heat and shock resisting neither the pump impeller nor casing is affected by temperatures up to 150 deg. Fah. in standard design, and 200 deg. Fah. in special design. Hot acids, or brine cooled liquids may be pumped with equal facility. Such rigorous plant problems as pumping hot muriatic acid are economically solved. The interior of the new glass pump allows the material flowing within it to be examined at all times. The capacity of the standard unit, with balanced impeller rotating at 1760 r.p.m. without appreciable vibration is 6000 gallons of acid or other liquid per hour.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

From Peace to War

The change over from peace to wartime conditions in the iron and steel industry was made with extraordinarily little disturbance. For some months of course the industry had been operating practically at capacity on material required for national purposes, and the only difference, therefore, was that the steelworks had to concentrate to an even greater extent than previously upon this particular work with the result that orders for steel required for private commercial uses were relegated to the background. It was anticipated that the first consequence of a war would be an Order controlling iron and steel. This was published at the beginning of the week and dated September 1st. It will be remembered that after the September crisis it was announced that the machinery of the British Iron and Steel Federation, (the steel manufacturers' organisation) would be utilised by the Ministry of Supply for the control and Sir Andrew Duncan, the Independent Chairman of the Federation, has become Controller. Under this Order licences are necessary to acquire iron and steel goods and certain raw materials; but provision is made for exemption, by notice, from the necessity to obtain a license in favour of certain classes of purchasers and for certain purposes. A notice is being issued concurrently with the Order providing for the exemption of the main classes of first priority users, namely Government Departments, and purchasers requiring goods for Civil Defence purposes and railway, shipbuilding and coal mining undertakings. Goods forming the subject of existing contracts are also exempt from licensing but may be subject to certain priorities. All purchasers of small quantities of goods (not exceeding 10 cwts.) and purchasers from stock-holding merchants (during a period of 14 days from the date of the Order) are also exempt from licensing. No licenses are required for dealing in scrap iron and steel. Maximum prices are established for the principal iron and steel products Prices are given in the second schedule to the Order and are basis prices only, extras, rebates, etc., being in accordance with the scales of "extra" at present ruling. The prices scheduled are those current in the industry and it is contemplated that they will remain unchanged until October 31st. Further information may be obtained on application in writing to the Iron and Steel Control, Ministry of Supply, Steel House, Tothill Street, London, S.W.1. Envelopes and letters must be marked "Licensing".

The Pig Iron Market

The country enters upon the war with larger and more assured supplies of pig iron than might have been the case had the trouble burst upon us in the early part of this year or at the latter end of 1938. Then a temporary decline in business had caused a number of blast furnaces to suspend production. In the early part of this year, however, the demand for most qualities of pig iron increased enormously and on the verge of the outbreak of war pig iron outputs generally speaking were expanding and stocks of materials were satisfactory. The steelmakers can face the future with an assurance of security so far as supplies of basic iron are concerned. Most of the consumers of hematite have covered their forward requirements for a long time ahead. Since the price was reduced 5s. per ton at the end of June consumers of hematite have bought liberally, and specifications against existing contracts have reached them on a generous scale. As a result consumers are well placed and although the demand under wartime conditions may be expected to expand the question of supplies is not likely to present any difficulty. Some of the consumers in this district have for a long time used good quantities of Midland brands and this practice is continuing. Business in the Midlands in foundry grades has been active, as naturally light castings makers have shown a desire to cover their needs for several months ahead. This industry is not expected to participate to a great extent in the war-time demand, but recently there has been some improvement in commercial requirements. Business in high phosphoric foundry iron remains active, and the outbreak of war has not increased the call for this quality, probably because the consuming industries were previously taking this iron with considerable freedom. The Scottish market for pig iron has shown few reactions to the outbreak of hostilities. Consumers were well provided with stocks and so far as foundry iron is concerned most of them are in a position to carry on without worrying about fresh supplies. Hematite also is being taken up in good quantities.

Scotland and the North

The Scottish iron and steel industry is entering the war with sufficient work in hand to keep it operating at full capacity for several months. For a long time the steelmakers have been subjected to great pressure from consumers to accelerate deliveries and the declaration of war against Germany has had little effect upon the position other than to increase the number of users asking for the rapid execution of their orders. The inability of the steelmakers to meet these requests has led to a rush to buy from stockholders. This branch of the trade has, generally speaking, adopted a conservative attitude, and although the call has been met wherever possible the uncertainty of the outbreak has occasioned a certain amount of discretion in selling. A very large proportion of the production of the Scottish steelworks for several months past has been for Government purposes and ordinary commercial work has had to give priority. It is natural to assume that for a time at any rate the whole capacity of the industry will be required for national purposes, and the steelmakers during the past week have been reluctant to commit themselves by accepting orders on private account. It must be expected that for a time this situation will rule; but when the priority system which has been istituted gets into working order much of the inconvenience thus caused should disappear. Structural engineers, shipbuilders, locomotive builders, and marine engineers are all fully employed and the first-named continue to take huge deliveries of joists and sections. Large tonnages of plates, also, are passing into consumption and there is little room left in the steelmakers' programmes to deal with new business. The sheet mills are in the position they have occupied for weeks, of having their whole production taken up by work for national purposes, and they are unable to accept fresh orders for commercial purposes except for indefinite delivery. Re-rollers are working under extreme pressure and there is an uninterrupted flow of small bars, sections and strip into consumption. The wrought iron makers have less business in hand probably than any other section of the industry, and the works are not more than moderately employed. They are, however, beginning to receive an overflow from the steel market which may be expected to develop. The Sheffield industry and the other steel producing districts in Yorkshire are working at top pressure. There is a very large output of basic steel from the Sheffield works, and large tonnages of special and alloy steel are being taken up by users. The demand for acid steel, also, is equal to the productive capacity of the works.

Non-Ferrous Metals

The non-ferrous metal trades passed from peace to wartime conditions with a noticeable absence of fuss. Anticipations were realised and the copper, lead and zinc trades were almost immediately placed under official control. No Order has been issued relating to tin, but presumably that trade is sufficiently under the control of the authorities through the Buffer Pool. The machinery of the Control will be provided by the British Metal Corporation and the Chairman of that company, Capt. Oliver Lyttleton, has been appointed Controller. The Order relating to copper, lead and zinc prohibits for the time being the purchase of these metals for consumption except under license. Licenses are not required to obtain deliveries against existing contracts, or for purchases for the purpose of enabling Government contracts to be fulfilled. It is permitted also to buy copper, lead and zinc for the purpose of necessary repairs not requiring more than one ton of each metal. The Order calls for certain information regarding stocks of copper, lead and zinc and certain manufactures of these metals from persons engaged in these trades. The export of unwrought copper, unwrought lead and unwrought zinc and spelter, of non-ferrous scrap and old metal is prohibited except under license from the Export Licenses Department of the Board of Trade. So far no maximum prices have been issued for these non-ferrous metals, but it is generally expected that this will be done in the near future. The question of War Risk Insurance which is regulated by another Order will, of course, have to be taken into consideration in fixing these prices which may, therefore, be at a higher level than those ruling before the outbreak of hostilities. At a meeting of the members of the London Metal Exchange held on September 4th, it was decided to open the market on Wednesday, September 6th, at Whittington Avenue at noon for one session only, for the purpose of levelling positions to enable a clearing to be held the following day. This clearing will govern all unsettled positions up to and including Wednesday, September 6th and the settlement price will be that fixed on August 31st.

Copper, Tin, Lead and Spelter

The situation in the copper market is very satisfactory and since war was declared no consumers have found difficulty in obtaining their full requirements. Metal in this country has not been commandeered and it may be taken for granted, therefore, that the authorities are well content with the position. It has not been necessary to prohibit individual transactions although consumers naturally have to obtain licenses to enter into new purchases. Considerable interest is, of course, evinced in the maximum prices which it is anticipated will be published shortly. . . . The fact that no mention of tin was made in the Order affecting copper, lead and zinc may be taken as an indication that the metal is sufficiently under control to obviate its inclusion in the order relating to copper, lead and zinc. Presumably the Buffer Pool is in a position to meet any demands which may be made upon it and consumers, therefore, are in as comfortable a position as can be expected at the outbreak of a war. . . . In the case of lead also there have been no complaints on the part of consumers, most of whom are well covered by contracts entered into some time ago. Deliveries are being made at a satisfactory rate against these commitments and the position does not give rise to any anxiety. Similar conditions also prevail in the spelter market in which supplies are readily obtainable.

Current Business

A contract for a hospital ship of the 1939 programme has been placed by the Admiralty. Guest & Chrimes Ltd., makers of sluice valves, will shortly open a branch office in Johannesburg, of which Mr. W. H. Firth a member of the company's staff, will be in charge. The English Steel Corporation Ltd., has constructed for its key men engaged in essential services, cast steel "pillbox" shelters with walls 1½in. thick, capable of resisting bomb splinters, blast and falling debris. Each box is designed to hold three men.

The Department of Overseas Trade announces that the following contracts are open for tender: Noroeste do Brazil Railway Administration: lathes, planing machines, drilling machines, screw-cutting lathes, metal shearing machines and saws, grinding machines, furnaces, electric sand sifter, a spring tempering oven, electric welding set, steam hammer, hydraulic press, woodworking machinery, electric motors for operating machines, hand rivetting hammers, hand-drills and emery wheels, compressed air hoses, two generating sets (460 H.P.) driven by producer gas engines, a generating set (140 H.P.) driven by crude oil engine and a quantity of electric cables, wire, switches, etc. (Bauru, San Paulo, September 12th). Port Elizabeth Municipality: supply and delivery of quantities of galvanised steel poles, time switches, tail end boosters and e.h.t. cable (Port Elizabeth, September (14th). Bagdad District Water Board: Supply and delivery of quantities of centrifugally cast iron or steel pipes (Bagdad, Iraq, September 16th). Egypt, Ministry of Public Works: supply, delivery and erection of four electric pumping units comprising four high-tension motor pumps, two high-tension cables, switchboards, pipe specials, and valves (Cairo, September 30th). Australia, Queensland Department of Irrigation: Supply, delivery, and erection of one electrically driven pumping unit, comprising pump, motor, discharge column in well, shafting, control gear, &c. (Brisbane, October 11th). Cairo, Ministry of Public Health: Supply and erection at Damietta of electric materials and apparatus required for the extension of the existing electric network (Cairo, October 18th). Victoria Railways Commissioners: Supply and delivery c.i.f. Melbourne of quantities of steel boiler and firebox quality plates. (Melbourne, Sept. 27th).

Our Trade with India

A Survey of the Import Trade of India for the Fiscal Year from April 1st, 1938, to March 31st, 1939, shows that the total value of imports of all kinds decreased during that period by Rs. 21,44 lakhs, equal to 12 per cent., to Rs. 152 crores. Great Britain sent imports of all kinds in the period under review to a total value of Rs. 46,73 lakhs, against Rs. 51,96 lakhs in the previous twelve months. In spite of this apparent decline, the British share of the total import trade with India rose from 30 per cent. to 30·7 for the year ending March 31st. Great Britain, in fact, was the only country whose percentage increased, and this was mainly on account of larger imports of electrical machinery, locomotive engines and boilers, yellow metal, tinned plates and electric wire and cables. In the iron and steel section the aggregate trade in bars fell by more than half, from 51,000 tons valued at Rs. 97 lakhs, to 17,000 tons valued at Rs. 44 lakhs. Arrivals from the United Kingdom dropped from 19,000 tons (Rs. 40 lakhs) to 12,000 tons (Rs. 30 lakhs). Imports from Belgium declined from 12,000 tons to 1830 tons; from Luxemburg from 9700 tons to 194 tons; whilst from France only 276 tons were imported, compared with 7200 tons in the period 1937–38. The United Kingdom sent 12,300 tons of beams, channels, pillars, girders and bridgework, a decline from the previous total of 17,800 tons, the value being Rs. 21½ lakhs and Rs. 27 lakhs respectively. Imports from Belgium also declined from 3228 tons in 1937–38 to 2590 tons in the period under review; but on the other hand France sent 1901 tons, against 701 tons in the previous year. Trade in hoop and strip also registered a fall, the share of the United Kingdom falling from 19,200 tons in 1937–38 to 9200 tons, and the value from Rs. 38,2 lakhs to Rs. 20,5 lakhs. In this material all countries of supply share in the decline. In rails, chairs and fish-plates, however, trade advanced, and imports from this country rose from 980 tons valued at Rs. 2,6 lakhs to 2350 tons valued at Rs. 5,5 lakhs. Germany supplied only 2514 tons against 3633 tons in the previous year. Most of the reduced imports of galvanised sheets and plates were borne by Great Britain, who supplied only 12,750 tons (Rs. 28,3 lakhs) compared with 25,700 tons (Rs. 54,4 lakhs) in the previous year. Trade in sheets and plates showed some expansion, the total imports rising from 23,800 tons to 26,000 tons. Of this trade the United Kingdom secured approximately 75 per cent., the imports advancing from 18,840 tons (Rs. 35½ lakhs) to 19,815 tons (Rs. 38½ lakhs).

Non-Ferrous Metal Average Prices

As might have been expected in view of the international disturbance, the official average prices for August issued by the London Metal Exchange show a rise in the values of copper and lead, although this is not spectacular. In the case of cash copper the average is £1 15s. 8d. above that for August, for three months £1 11s. 3d., and for electrolytic £1 15s. 2d. higher. Wire bars and best selected copper are £2 and £1 11s. 9d. respectively above the average for the previous month. Prices in the tin market are so much under control that little variation is permissible, and the average for cash tin and settlement are only 5d. and 3d. respectively higher than the figures for August, although the average quotation for three months shows a rise of 10s. 3d. The average price for lead for shipment during the current month rose by £1 5s. 9d. and for shipment in the third following month by £1 0s. 7d., the mean being £1 3s. 1d. up and the settlement quotation £1 5s. 4d. more than the August average. In the spelter market prices rose slightly, the average for current month shipment by 7s. 10d. and for the third following month by 6s. 6d. compared with those for August. The mean quotation averaged 7s. 2d. more and the settlement price 7s. 8d. above the average for the previous month. The following are the official average prices for August.

STANDARD COPPER ...	Cash...	£44	14	$5\frac{33}{44}$
	3 Months (Mean) ...	£44	16	$4\frac{17}{44}$
	Settlement	£44	14	$2\frac{5}{11}$
ELECTROLYTIC COPPER (MEAN)		£50	18	$3\frac{6}{11}$
DITTO DITTO WIRE BARS		£57	8	$4\frac{10}{11}$
B.S. COPPER (Mean)		£50	8	$7\frac{1}{4}$
STANDARD TIN	Cash (Mean)	£229	18	9
	3 Months (Mean) ...	£229	6	3
	Settlement	£230	0	0
LEAD For shipment the current month (Mean)		£16	0	$9\frac{6}{11}$
For shipment the third following month (Mean)		£15	17	$8\frac{17}{44}$
Mean		£15	19	$2\frac{38}{44}$
Settlement		£16	0	$6\frac{6}{11}$
SPELTER For shipment the current month (Mean)		£14	12	$6\frac{15}{22}$
For shipment the third following month (Mean)		£14	15	$2\frac{6}{11}$
Mean		£14	13	$10\frac{11}{22}$
Settlement		£14	12	6

Iron and Steel Products Control

UNDER the provision of the Defence Regulations, the Minister of Supply has established a control of the Iron and Steel Industry. Licences are required to acquire iron and steel goods and certain raw materials, but provision is made for exemption, by notice, from the necessity to obtain a licence in favour of certain classes of purchasers and/or certain purposes. A notice is being issued concurrently with the Order providing for the exemption of the main classes of first priority users, namely Government Departments, and purchasers requiring goods for Civil Defence purposes and railway, shipbuilding and coal mining undertakings. Goods forming the subject of existing contracts are also exempt from licencing but may be subject to certain priorities. All purchasers of small quantities of goods (not exceeding 10 cwt.) and purchasers from stock-holding merchants for urgent requirements (during a period of 14 days from the date of the Order) are also exempt from licencing. No licences are required for dealing in scrap iron and steel, but a licence is required from the Export Licencing Department of the Board of Trade for the export of scrap iron and steel and for certain iron and steel goods.

Maximum prices are established for the principal iron and steel products. Prices are given in the second Schedule to the Order and are basis prices only, extras, rebates, &c., being in accordance with the scales at present ruling. The prices scheduled are those current in the industry and it is contemplated that they will remain unchanged until October 31st next.

Further information may be obtained on application in writing to the Iron and Steel Control, Ministry of Supply, Steel House, Tothill Street, London, S.W.1. The notice of exemptions from licence issued by the Minister should be carefully studied before making appliction.

We print herewith the Control of Iron and Steel Order, 1939, dated the 1st day of September, 1939.

WHEREAS it appears to the Minister of Supply to be necessary for maintaining supplies and services essential to the life of the community and expedient that this Order should be made :—

Now therefore the Minister of Supply in pursuance of Regulation 55 of the Defence Regulations, 1939, hereby orders as follows :—

1. (i) No person shall acquire or agree to acquire any of the articles or materials of any of the descriptions mentioned in the first Schedule hereto situate in the United Kingdom on or at any time after the date on which this Order comes into force, except under the authority of a licence granted by the Minister, which licence may be granted subject to such conditions as may be specified or referred to in such licence or as the Minister may from time to time determine—Provided, however, that the Minister may by notice make such exemptions of persons or classes of persons or otherwise howsoever as he may think fit from the requirements of this paragraph under such conditions as may be stated in the notice.

(ii) No person shall dispose of or agree to dispose of any such articles or materials as aforesaid except to a person who produces a licence granted by the Minister authorising him to acquire these articles or materials as the case may be or who is exempted as aforesaid.

(iii) Any notice given by the Minister under this Article shall be published in such manner as shall appear to him to be best adapted for informing persons affected and shall have effect from the date of such publication.

(iv) Nothing in this Article shall be taken to prohibit or to restrict the delivery to and acceptance by a person carrying on the business of a carrier of any such articles or materials as aforesaid in the ordinary course of that business, or the delivery by and acceptance from such a person of any such articles or materials in the ordinary course of that business.

2. If any licence granted under this Order is revoked by the Minister of Supply the holder of the licence shall forthwith deliver up the licence as directed by the Minister.

3. No person shall buy or sell, or agree or offer or invite an offer to buy or sell, any articles or materials of any of the descriptions mentioned in the second Schedule hereto situate in the United Kingdom and for delivery in the United Kingdom on or at any time after the date on which this Order comes into force at a price exceeding the maximum price provided for in or calculated in accordance with the said Schedule, or such amended Schedule as may be in force at the time of delivery of the said articles or materials.

4. In this Order the expressions "acquire" and "dispose of" include respectively the taking and giving of possession.

5. This Order shall come into force on the 1st day of September, 1939, and may be cited as the Control of Iron and Steel Order, 1939.

Dated this 1st day of September, 1939.

FIRST SCHEDULE

Iron Ore of all classes—containing not less than 15 per cent. Iron ; Manganese Ore ; Scrap Iron and Steel fit only for the recovery of metal and for reprocessing ; Ferro-Alloys of all qualities, excluding ferro-alloys of Tungsten, Vanadium, Molybdenum, and Chrome ; All Iron and Steel products of all qualities and categories of the following classes :—

Pig Iron ; Ingots ; Billets, blooms and slabs ; Tinplate and sheet bars ; Plates, medium plates and sheets, coated, and not coated ; Angles, channels, tees, joists, piling sections and other sectional material, whether fabricated or not ; Rounds, rods, squares, hexagons, flats, and all other sections and shapes, black or bright ; Rails, sleepers, fishplates, and sole plates ; Wire Rods ; Tinplates, terne plates, black plates, and silver-finished plates ; Hoop and strip, hot or cold rolled ; Pipes, tubes and fittings however made ; Tyres, Axles, and Wheels ; Castings, blocks for forgings and pressings, forgings, stampings and pressings ; Wire, plain, barbed, coated and uncoated, wire ropes, wire netting, wire staples, chain link and square meshed fencing and wire strand, wire nails and screws ; Colliery Arches and accessories and pit props ; Bolts and nuts, washers, spikes and rivets ; Structures, including bridge, pier, tank and plate work.

SECOND SCHEDULE

MAXIMUM UNITED KINGDOM PRICES FOR IRON AND STEEL PRODUCTS

Home Trade basis prices per ton delivered are set out unless otherwise stated. Related prices, extras, allowances and rebates shall be in accordance with lists lodged at the offices of the Iron and Steel Control (Ministry of Supply).

PIG IRON.	£	s.	d.
Basic—			
(*a*) South Wales, N.E. Coast, Scotland, Mersey Ports, Lancashire, Cheshire, N. Wales and North Staffs...	4	12	6
(*b*) Sheffield	4	15	0
(*c*) South Staffordshire	4	17	6
Hematite—No. 1 Mixed Nos., S. & P. over 0·03 per cent. but not exceeding 0·05 per cent.			
(*a*) Scotland, N.E. Coast and West Coast England	5	15	6
(*b*) Sheffield	6	1	0
(*c*) Birmingham	6	7	0
(*d*) Wales—Welsh Iron	5	11	0
Foundry and Forge Pig Iron—No. 3 Iron Class 2, delivered Middlesbrough	4	19	0
FORGING INGOTS up to 0·60 per cent. C.	9	9	6
BILLETS, BLOOMS, AND SLABS FOR RE-ROLLING.			
Basic—			
(*a*) Soft U.T. (100-ton lots)	7	7	6
(*b*) Soft T.G. up to 0·25 per cent. C. (100-ton lots)	7	12	6
(*c*) Hard, 0·42 per cent. to 0·60 per cent.	8	10	0
(*d*) Silico-manganese	11	2	6
(*e*) Free-cutting	9	2	6
Siemens Martin Acid—			
(*a*) Up to 0·25 per cent. C.	10	7	6
(*b*) Case-hardening	11	5	0
(*c*) Silico-manganese	11	2	6
BILLETS, BLOOMS AND SLABS FOR FORGING AND STAMPING.			
(*a*) Basic Soft, up to 0·25 per cent. C.	9	0	0
(*b*) Basic Hard, 0·42 per cent. to 0·60 per cent. C.	9	7	6
(*c*) Acid, up to 0·25 per cent. C.	10	17	6
(*d*) Case-hardening	11	15	0
(*e*) Silico-Manganese	11	12	6

ALLOY STEELS.

	1 per cent. Nickel	Nickel-Chrome	Nickel-Chrome Molybdenum
Billets, 2in. up to and including 10 in., delivered all districts	£14 0 0	£25 5 0	£31 5 0
Stamping Bars, 3in. diam. and up, round or equivalent sectional area	19 12 0	32 2 0	39 2 0

	£	s.	d.
TINPLATE AND SHEET BARS, delivered all districts not less than 25 tons of one width and quality, 9 lb. and over per foot for bars under 8in. down to 18 lb. and over for bars 14in. and over	7	5	0
WIRE RODS.			
Basic—all sizes with exception of over 7/0 gauge and 6 gauge delivered in all districts in United Kingdom except (*a*) Birmingham and Scotland, and (*b*) Southern Joint Area :			
Soft Basic 0·08 per cent. to 0·25 per cent. C.	11	7	6
Hard Basic 0·42 per cent. to 0·60 per cent. C.	14	10	0
Free-Cutting	13	10	0
Acid—up to 0·85 per cent. C. all sizes with exceptions of over 7/0 gauge and 6 gauge, delivered all districts :			
Ordinary	18	1	0

MANUFACTURED IRON.

	Crown Iron £ s. d.	No. 3 Bars £ s. d.	No. 4 Bars £ s. d.
(*a*) English and Welsh delivery, usual districts	12 5 0	10 17 6	11 7 6
(*b*) Scottish delivery, usual districts	12 5*0	12 0 0	12 5 0
(*c*) Irish delivery, f.o.q. Belfast	12 17 6	11 10 0	12 0 0

HEAVY STEEL PRODUCTS.

	Joists and Angles £ s. d.	Plates £ s. d.
Deliveries to Principal Districts :		
(*a*) North East Coast, Northern Joint Area, Scotland, Belfast shipyards and shippbuilders at Thorne, New Holland and Gainsborough	10 8 0	10 10 6
(*b*) Leeds and District, Midland area and South Wales	10 8 0	10 13 0
(*c*) Southern Joint Area	10 10 6	10 15 6

	£	s.	d.
Medium Plates (under $\frac{3}{16}$ in. thick) all deliveries—			
Weighing 6 lb. or more per sq. ft.	11	12	6
Weighing less than 6 lb. but not less than 4·81 lb. per square foot	12	2	6
Chequered Plates ($\frac{1}{4}$in. thick and upwards)—			
(*a*) North East Coast and shipbuilders at Thorne, New Holland and Gainsborough	12	0	6
(*b*) N. Jt. Area ; Scotland, Leeds and District ; Midlands and S. Wales ; Southern Jt. Area	12	3	0
RAILS.			
Heavy Rails—60 lb. per yard and over, lots of 500 tons and over ; F.O.T. Maker's works	9	3	0
Light Rails—Light flange rails, up to and including 25 lb. per yard	11	2	6
COLLIERY ARCHES AND ACCESSORIES :			
4 by 2½ by 2 and 4 by 2½ by 2½, single radius with straight, horse shoe or splayed legs with one fish-plate joint, complete with one pair of fish-plates and the necessary bolts and nuts	11	12	6
Arches as above but *without* fishplates, bolts and nuts	11	10	0
Fishplates (for Arches) alone	17	0	0
Plain Cambered Girders, 4 by 2½ by 2 and 4 by 2½ by 2½ with minimum camber of 2·in. in centre, for use underground only	11	5	0
Corrugated Straps, Roofing or Benk Bars	10	12	6
RE-ROLLED STEEL PRODUCTS.			
Angles and Tees, 4 united inches and under, and Channels 3in. web. and under : basis U.T.	11	2	0
Bars—Flats 5in. wide and under and *Rounds and Squares* under 3in. U.T.	11	12	0
Free-Cutting Bars—Rounds	13	4	0
Hoop and Strip—hot rolled (excluding hoop and strip for Gas, Steam and Water Tubes) U.T.	12	7	0
Hoop and Strip—cold rolled—			
Basis. Hard Bright—in flat lengths or coils (not annealed)—			
1in. to under 1¼in. by 12 G. and thicker ; 1¼in. to 6¼in. by 20 G. and thicker ; Over 6¼in. to 8¾in. by 16 G. and thicker ; Over 8¾in. by 14 G. and thicker	19	0	0
Products made from Basic Hard Steel—			
0·42 per cent. to 0·60 per cent. C.	12	12	6
Products made from Siemens Martin Acid Steel—			
Up to 0·25 per cent. C.	14	10	0
Spring Steel Bars—			
Laminated			
(*a*) Basic 0·42/0·60 per cent. C. Water Hardening	12	12	6
(*b*) Acid 0·42/0·60 per cent. C. Water Hardening	16	3	6
Siemens Martin File Steel—			
Long lengths 12in. and up			
(*a*) Acid	17	15	0
(*b*) Basic	15	2	0
Ferro-Concrete Bars—delivered station or siding	10	19	6
Rivet, Bolt and Nut Bars (4 ton lots)	11	15	0
BRIGHT DRAWN STEEL BARS.			
(*a*) Untested	16	11	0
(*b*) Tested and Guaranteed	17	11	0
(*c*) Free-Cutting	18	7	6
SHEETS.			
(*a*) Black, 24 G.	14	15	0
(*b*) Galvanised, corrugated, 24 G.	17	5	0
TINPLATES.			
I.C. Cokes 20 by 14 per box, F.O.T. Maker's Works	1	0	4½
TUBES.			
Black welded steel gas tubes 1in. diameter at 68¾ per cent. off list price.			

NOTICE

The Minister of Supply hereby GIVES NOTICE THAT

(*a*) Articles and materials of the various categories listed in the First Schedule to the Control of Iron and Steel Order, 1939, may be supplied and received without restriction as to licence until further notice for use directly or indirectly for the following customers and/or purposes :

1. Government Defence departments,
2. Other Government departments,
3. Local authorities for civil defence purposes,
4. Persons requiring supplies under the Civil Defence Act, 1939, or otherwise for air raid precautions,
5. Railway companies for repair and maintenance work,
6. Shipbuilders, ship repairers and marine engineers,
7. Collieries,
8. Persons having agreed prior to the date of the Order to purchase any of the articles or materials contained in the First Schedule of the Order, for the purpose of delivery against such purchase subject to priority being given by the suppliers to deliveries under 1. to 7.
9. Persons purchasing from stockholding merchants out of their stock for urgent requirements during 14 days from the date of this Order.
10. Persons purchasing quantities of 10 cwt. or less.

(*b*) Scrap iron and steel fit only for the recovery of metal or for reprocess may be supplied and received without restriction as to licence until further notice.

A. WATSON,
A Principal Assistant Secretary of the Ministry of Supply.

French Engineering Notes

(From our own Correspondent in Paris)

The War

THE drawing of this country with Great Britain into a European conflagration finds France far better prepared to carry out the duties devolving upon her than she was in 1914, when everything had to be learned in the art of building up a strong economic defence behind the military forces engaged in war. No time was lost after the last war in evolving a plan that provided for manufacturing facilities and a home production of necessary commodities that gave rise to the policy of self-sufficiency adopted by so many Continental countries, and although that policy has been carried to an extreme by Germany and Italy, it rapidly weakened in France, where its principle was recognised to be unsound, and the idea of self-sufficiency stopped at a point beyond which it was seen to be heading towards national impoverishment. As wars cannot be won without production resources behind the lines, industry had to be developed to provide what was necessary, as far as possible. During the past twenty years industrial progress has been one of the country's greatest achievements. It has been accelerated by efforts to retrieve industry from the critical situation into which it had fallen through the effects of the labour revolt following upon a period of economic depression. Huge sums of money have been spent upon the equipment of works and factories. So far as concerns industrial production, and the possibility of obtaining all the raw materials needed, this country, with its skilled workers and capable technicians, has a defensive power behind the lines that can hold for any length of time. The mobilisation plan drawn up many years ago covered the entire manufacturing industry as well as the whole civil population, so that the Minister for Defence can utilise the country's production resources to the fullest advantage. As stated last week, all the men in works and factories engaged on contracts for the three services have been mobilised, and now that a general mobilisation has been decreed it may be expected that the combined economic and armament organisation will be carried out in its entirety without loss of time. Other evidence of order and preparedness is the manner in which the railways have been requisitioned by the military authorities and the Government's statement that the National Railway Company will be able to run sufficiently adequate services for the public needs. Since the requisition the company has dealt smoothly with the evacuation from Paris of children and old and sick people, and now that existing services have been stopped a rearrangement will have to be made compatible with military necessities. The conditions of civil defence differ in some respects from those in Great Britain. French industrial areas are not so large and thickly populated, and the greater part of the country offers relative security for a dispersal of population away from strategical points of attack. Such dispersal necessarily falls mainly on the railways, and while omnibuses, lorries and private cars have been largely requisitioned there are, at the moment, still facilities for leaving Paris. All the arrangements made have inspired general confidence.

Wage Adjustments

Although the question of wage adjustments has lost interest for the time being, it is nevertheless bound to come to the fore when conditions return to normal. The idea of adjusting wages automatically to the cost of living was supposed to ensure for wage earners a remuneration that would always have the same purchasing power. Upon this basis, the conditions of compulsory arbitration entitled men to claim an advance when the official index figures showed an increase of at least 5 per cent., although it could not be demanded in less than six months after a previous increase. This index figure is obtained by a method of computation that aims at recording variations in the cost of living of a working family of four persons. There are committees all over the country which, every three months, verify local prices covering five categories of domestic expenditure, and these data are taken in conjunction with the general statistical returns to fix uniform index figures based upon the reference year of 1930. During the past two years the index shows an increase of 25 per cent. By fixing as a basis for wage adjustments a general index of living costs it is obvious that the adjustments do not bear equally on all industries. In some of them wages are a more important factor in prime costs than in others. Production may be too competitive to allow of an additional load of wages for a given output being carried by increased selling prices, and under existing conditions a rise in wages may eliminate all profit whatsoever. There is an inequality all round. At first, arbitrators appointed by the Government to settle disputes after failure of conciliation kept particularly in mind the factor of living costs, and an automatic raising of wages was followed by an increase in the official index figures. It was seen that the system could not work automatically. Fortunately, the law had made a reservation that while the men could claim an adjustment of wages based on the index figures, advances should not be awarded if employers were able to prove that, after effecting all possible economies, they were incapable of paying higher wages. Then towards the end of last year the Government's industrial policy urged the importance of increasing and cheapening production as a means of reviving the national economy and lessening the cost of living. Arbitrators were led to examine more fully the effect of wage advances on the industries concerned. The men's claims were reduced, and many of them disallowed, while the Superior Court of Arbitration has quashed awards granting wage advances. In one case, manufacturers proved that their particular industry was in so precarious a situation that higher wages would necessarily result in the closing down of works. The men admitted that they were aware of this situation, and disclaimed all responsibility for it. The attitude of official arbitrators now is that settlements of wage disputes can only be made in the interests alike of employers and workers, and that higher wages are detrimental to workers if they entail a reduction or loss of employment.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

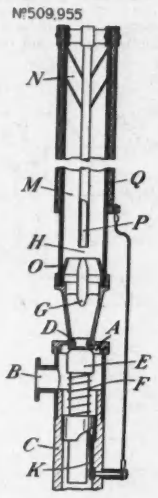
Copies of Specifications may be obtained at the Patent Office' Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR

509,955. June 1st, 1938.—GAS BLAST ELECTRIC CIRCUIT BREAKERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

The invention relates to a circuit breaker operating with flowing pressure gas for extinguishing the arc. A is the arcing chamber to which the pressure gas is supplied through the branch B by way of a control valve. The arcing chamber may be metallic and mounted on an insulator C or may be made of insulating material. D is the fixed contact of the circuit breaker, having the form of an outwardly flaring nozzle which is closed by the movable contact E. The movable contact is loaded by the closing spring F. In the axis of the circuit breaker is disposed the arc intercepting contact G, which is also used as one electrode of the spark gap H, the counter electrode P of which, also lying in the axis of the circuit breaker, and in the blowing direction of the pressure gas, is connected with the protective

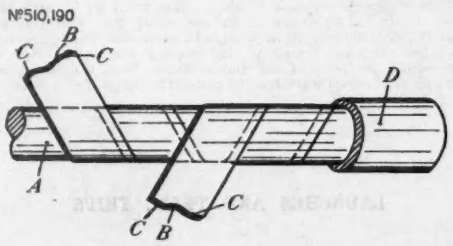


resistance Q of the circuit breaker, which is conductively connected through the sliding brush K with the movable contact E of the circuit breaker. The resistance Q consists, for instance, of resorbite and preferably has the form of a cylinder which is slipped over the blowing chamber M of insulating material, which forms a continuation of the pressure chamber A of the circuit breaker. N is an exhaust cooler and silencer. The electrode P of the spark gap is a hollow electrode. The arc which bridges the spark gap H on the occurrence of a returning voltage having a steep front puts the resistance Q into circuit and is drawn by the pressure gas leaving the arcing chamber M by way of the hollow electrode P into the latter and, by being swept over on all sides, is rapidly and with certainty extinguished at all switching conditions. The guiding insertion O assists the extinguishing of the arc in an effective manner.—*July 25th*, 1939.

TRANSMISSION OF POWER

510,190. February 8th, 1938.—ELECTRIC CABLES, Felten und Guilleaume Carlswerk Actien-Gesellschaft, of Köln-Mülheim, Germany.

According to this invention, use is made of a substitute covering for the lead sheathing of cables, consisting of several layers of metal foil wound on in different layers, each metal foil being coated on one or both sides with a lining of synthetic organic material of the polyvinyl or polyacryl type, such as polyvinyl chloride, polyacrylic acid ester, or mixed polymerisates of the two, over which plurality of lined metal foils there is provided a

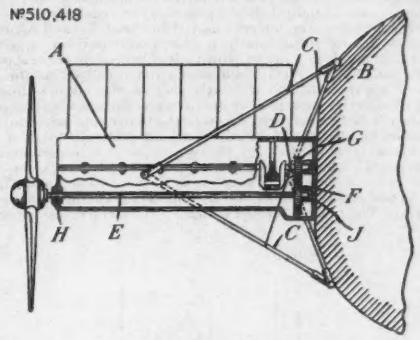


further sheathing of the synthetic organic material, if desired mixed with suitable plasticisers. The metal foils preferably consist of aluminium and they are very thin, preferably 0·1 mm. thick. The linings on one or both sides of the metal foils are also very thin. The lined metal foils may be wound around the core in an overlapping or abutting manner, and they are preferably stuck or sintered together by heat at their overlapping or abutting edges. A is the cable core, B coverings of aluminium foil, C the linings of polyvinyl chloride provided on both sides of each aluminium foil, and D the outer sheathing of polyvinyl chloride.—*July 28th*, 1939.

AERONAUTICS

510,418. November 30th, 1938.—DRIVING OF AIRCRAFT PROPELLERS, Junkers Flugzeug-und-Motorenwerke Aktiengesellschaft, Junkerstrasse, Dessau, Anhalt, Germany.

In many cases the propeller or airscrew in front of an aeroplane engine is carried on a separate shaft which is mounted in the engine casing and connected with the engine shaft through a reduction gear situated in the forward portion of the engine casing, *i.e.* that portion adjacent to the airscrew. With such an arrangement, the reaction torque of the gear, which is transmitted rearwardly through the engine casing to the part carrying the latter, applies a wrenching stress to the casing at a point which is comparatively remote from that at which it is connected and held against turning. The engine casing is extremely sensitive to such wrenching stresses and is liable to become warped, the deformation giving rise to relative movements between the component members of the casing which are undesirable. The object of the invention is to produce an arrangement for driving the propeller of an aircraft in which these defects are avoided. As shown the crankcase A of the engine is secured on the supporting part B (aeroplane fuselage or wing) so that it extends forwardly therefrom. The crankcase is secured in position by two sets of struts C, C which prevent it twisting in relation to the supporting part. For transmitting



the engine torque from the crankshaft D to the propeller shaft E a reduction gear consisting of the pinions F and G is provided. This gear is housed in that part of the crankcase which is adjacent to the supporting part and particularly close to the point at which the crankcase is prevented from twisting. The propeller shaft is mounted in the bearings H, J, the larger pinion F mounted on the shaft gearing with the smaller pinion G mounted on the crankshaft. The bearings of the propeller shaft are so placed that the shaft extends into the interior of the crankcase. With an arrangement of this kind the reaction torque of the reduction gear occurs in the immediate vicinity of the point at which the crankcase is secured against twisting in relation to the supporting part. Consequently as the torque is not transmitted through practically the whole of the crankcase it cannot apply torsion stresses to any considerable portion of the case and set up any relative movement between the component parts.—*August 1st*, 1939.

BUILDING

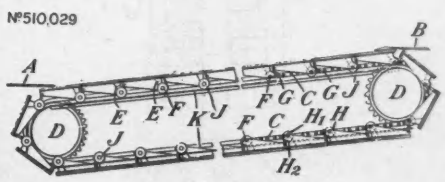
510,485. August 26th, 1938.—DAMP RESISTING COMPOSITION FOR BUILDING STRUCTURES, G. M. Skinner Pty., Ltd., formerly known as G. M. Skinner, Ltd., 42, Pine Street, Chippendale, near Sydney, New South Wales, Australia.

The bituminous paint described is particularly adapted for treating walls of buildings to impart to them water resisting quality, to check water seepage and water sweating, or for tempering cement grouting, mortar, or plaster. In the manufacture of the composition there is first formed a thick slurry of a pug of twelve parts tenacious plastic clay and fifteen parts shell lime in thirty parts of water by beating and mixing. Then four parts of bitumen are heated, to liquify it, and dissolved in twenty parts of mineral oil, thoroughly blended, and then stirred in six parts of water to produce an homogeneous emulsified product. To this product is added one part of caustic soda after having been broken down in two parts of water to form a strong lye, and two parts of calcium chloride dissolved in approximately four parts of water, and both of these solutions are added to the mixture which is agitated, whilst tepid. The viscous product thus obtained is quite homogenous; it does not precipitate solids on standing, and when diluted to a desired consistency may be used as a paint. For other use two parts of the product are thinned with two parts of water and this thinned mixture is worked up with cement mortar ingredients and a sufficiency of additional water to bring the cement mortar to the desired slump test for use. This mortar is then applied as grouting for stone or brick construction or as a plaster to waterproof it. The mortar is improved in hardness. The proportions of all ingredients are stated in weights.—*August 2nd*, 1939.

MISCELLANEOUS

510,029. March 25th, 1938.—CONVEYORS AND MOVING PLATFORMS, William Sebastian Graff Baker, 4, Edwardes Square, Kensington, London, and London Passenger Transport Board, 55, Broadway, Westminster, London, S.W.1.

In the construction of conveyors or moving platforms, the working surfaces of which are constituted by a series of platforms or treads of an appreciable width, it is common practice to mount the surface members on chains having links equal in length to the width of the surface members. Such a chain must usually be driven by a chain wheel or sprocket having comparatively few teeth which gives an uneven rate of drive or by a sprocket sufficiently large in diameter to ensure that there are sufficient teeth to overcome this unevenness of drive. The object of this present invention is to enable a chain to be used

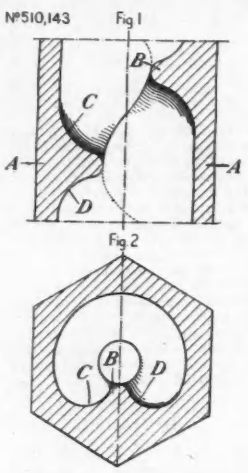


having a pitch smaller than the width of the surface members, thereby enabling a smooth drive to be obtained with a small driving wheel. Referring to the drawings A is the bottom landing level and B the top landing level. The individual treads are connected to the chains C arranged one at each side below the treads. The chains pass over the end pulleys D D, one of which is driven. Each tread is attached to the chain by a triangulated linkage. At the leading edge of each tread there is a rigid bracket E, preferably of channel form, which extends down to an axle F extending across between the two chains. Each tread is a substantial metal plate having depending lateral edge flanges in the form of inverted channel members, which are rigid with the treads, brackets and the axles. The following edge of each tread is connected to the leading edge of the flange pieces at each side by a link G. The above arrangement is to

provide a triangulated linkage capable of moving to some limited extent about the pivot points H, H_1, and H_2, with the result that the treads can take up such a position and separate longitudinally from each other to such an extent as may be required, and as indicated for allowing the chain and the treads to pass over the end pulleys. For determining the correct position of the leading edge of each individual tread over the effective area of the travelling platform portion, the axles F carry also the wheels J, which are adapted and arranged to travel over the track K. In order to prevent the leading edges of the treads from fouling the following edge of the tread in front of it, the leading edge of each is chamfered.—*July 26th* 1939.

510,143 February 17th, 1939.—FILLING MATERIALS FOR GAS WASHING TOWERS, H. A. Brassert and Company, Limited, Granite House, Cannon Street, London, E.C.4 (*a communication from H. A. Brassert and Company, Berlin-Charlottenburg 2, Hardenbergstrasse 7, Germany*).

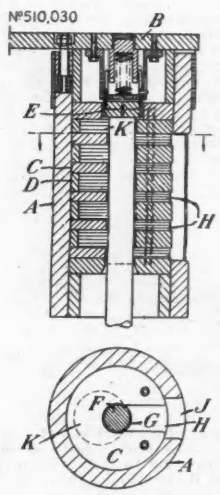
In this invention, there is provided a tubular gas washer brick having a substantially helical upstanding internal rib or thread which is joined to the internal wall of the brick by well rounded surfaces having substantially no horizontal portion, and the inner nose of which is of comparatively large radius of curvature. With such a construction sediment cannot collect on the rib to any appreciable extent, and owing to the large radius of curvature of the inner nose of the rib water does not tend to drip off the rib, but runs down and on to the under side, whereby the efficiency of the washer is enhanced. A preferred form of the invention is illustrated in the accompanying diagrammatic drawings, in which Fig. 1 is a central sectional elevation of a brick constructed in accordance with the invention; and Fig. 2 is a section on the line A-A, the brick having been rotated through 90 deg. The brick is formed with a cylindrical passage carrying



an inwardly projecting helical rib B extending the whole length of the passage. In order to prevent sediment from collecting on the shelf formed by the rib the latter is merged into the brick wall by surfaces C, D of large radius (for example of 1in.), having substantially no horizontal portion. Similarly, in order to prevent water dripping off the nose of the rib, the nose section is of large radius of curvature (for example of $\frac{1}{4}$in.), so that water tends to run down over it on to the under surface D, whereby a greatly increased wetting effect is produced. Cleaning of the gas is effected by virtue of the fact that the dust particles impinge on the brick surface and are washed off by water flowing over the surface. Hitherto, the under surfaces C of the rib were not efficiently wetted, and it will be appreciated that, by means of the present invention, this disadvantage has been eliminated. The gas to be cleaned may be passed through the bricks either in the same or in the opposite direction to the water. It will be seen from Fig. 2 that, when viewed end on, an opening can be seen right through the brick. In order, however, to increase the area over which the gas impinges on the brick, the rib B may project so far inwardly that no aperture can be seen when the brick is viewed end on.—*July 27th*, 1939.

510,030. March 30th, 1938.—ARC CONTROL DEVICES FOR ELECTRIC CIRCUIT BREAKERS, The General Electric Company, Limited, of Magnet House, Kingsway, London, W.C.2, and Charles Joseph Oliver Garrard, of The General Electric Company, Limited, Engineering Works, Witton, Birmingham.

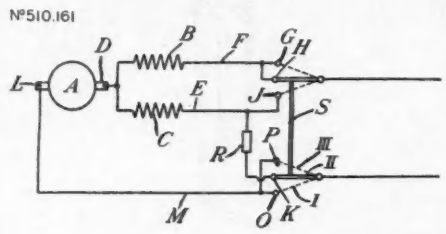
The arc control device described in this specification is arranged when associated with a circuit-breaker to be supported by the top plate of the tank of the electric circuit breaker, and the device is supported so as to be wholly immersed within



the oil. The device comprises a cylinder A of electrically insulating material which is arranged vertically and is bolted to a contact supporting member B and within the cylinder there is a pile of circular plates C and D of electrically insulating and arc-resisting material. The fixed contact E is arranged within the cylinder above the plates C and D and the moving contact F of the device is arranged to pass through a centrally and longitudinally arranged passageway G in the plates C and D and to abut against the fixed contact E which is provided with a small degree of resilience. Actually, there are ten plates C and D in all and they are secured within the cylinder one above the other with their adjacent surfaces in contact. The plates C and D comprise two sets, the plates of the sets alternating with each other, and the first set includes plates C which are all of equal thickness and are similarly provided with a slot H extending from the central aperture in a plate C to the periphery. These slots H are arranged one above the other and form spaced lateral vents connecting the central passageway G formed by the central apertures in the plates C and D with the liquid in the tank by way of a longitudinal slot J in the wall of the cylinder. The plates D of the other set are all similar except that the uppermost plate which is just below the fixed contact E of the device is thinner than the remainder and each of the plates D is cut away to provide an enlargement K of the central aperture in a plate D. These plates D are arranged with the enlargements K one above the other and diametrically opposite to the slots H in the plates C of the first set. The fixed and moving contacts E and F are, of course, suitably connected to the electrical circuit which they are arranged to control and upon separation of the contacts E and F, the moving contact F passes down the central passageway G in the plates C and D and an arc, if formed, is formed in this passageway G. The pressure set up by the arc within the substantially enclosed chamber formed by the arc control device produces a flow of insulating liquid from the vents H to extinguish the arc.—*July 26th*, 1939.

510,161. January 27th, 1938.—CONTROL OF ELECTRIC SERIES-WOUND MOTORS, Robert Bosch G.m.b.H, 4, Militärstrasse, Stuttgart, Germany.

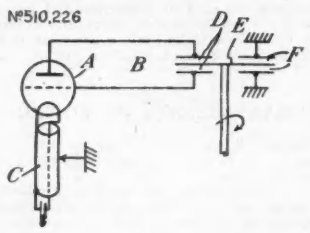
The object of this invention is to ensure that when the motor is stationary, the exciting field prevents movement of the armature. A is the armature of the motor, and B and C are two field windings wound in different directions. One end of each of the two windings is connected with one pole D of the armature, while the other ends of the two field windings are connected respectively through switch leads E and F with contacts G, H, and J, K, of a double pole change-over switch S. The other pole L of the armature is connected by a switch lead M with two contacts O and P of the change-over switch. The contacts are so arranged relative to each other that in the switching position I, the winding C and the armature are con-



nected in series. In the position II the two field windings only are connected in series, whilst in position III the winding B and the armature are connected in series. In the switching position II, in which the two field windings are connected in series, the two windings mutually support each other, and thus produce a very strong field which is effective to prevent movement of the armature. In order to protect the field windings from overloading in the switch position II, a resistance R may be put into the switch lead from contact H or K.—*July 27th*, 1939.

510,226. January 18th, 1939.—ULTRA-SHORT WAVE OSCILLATION GENERATORS, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 30 Hallesches Ufer, Berlin, Germany.

This invention concerns ultra-short wave oscillation generators of the type comprising a back coupled valve. A valve A has an oscillatory circuit B connected between its anode and its grid and an impedance C constituted by a length of outer tube or casing with a central conductor provided between the cathode and earth (or frame). The oscillatory circuit B consists of a wire loop and a capacity D, the latter being variable by a movable



conductor plate E which can be swung to an adjustable extent into the space between the two plates of the capacity D. The plate D is extended to serve also as the variable electrode of another variable capacity F whose other terminal is earth (or frame). It can be shown that the capacity F is effectively in parallel with the cathode impedance C, so that the cathode circuit can be tuned by varying it. By suitably shaping the plate E the result can be obtained that optimum back coupling conditions exist for all wave lengths within the range of adjustment.—*July 28th*, 1939

LAUNCHES AND TRIAL TRIPS

DARINA, oil tanker; built by the Blythswood Shipbuilding Company, Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, length 460ft. B.P., breadth 59ft., moulded depth 34ft., deadweight 12,100 tons. Engines, eight cylinder, four stroke, cylinders 650 mm. diameter by 1400 mm. stroke, constructed by John G. Kincaid and Co., Ltd.; trial trip, August 10th.

DOLABELLA, oil tanker; built by R. and W. Hawthorn Leslie and Co., Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, length 482ft. overall, breadth 59ft., moulded depth 34ft., deadweight 12,000 tons. Engines, eight cylinder, four stroke, cylinders 650 mm. diameter by 1400 mm. stroke; launch, August 15th.

HESPERUS.—Motor lighthouse tender. Built by Caledon Shipbuilding and Engineering, Co., Ltd., to the order of the Commissioners of the Northern Lighthouses. Dimensions: length 200ft., breadth 35ft., depth 15ft. 6in. Engines: two four-cylinder single-acting, developing 1070 B.H.P. at 230 r.p.m. Cylinders 340 mm. bore by 570 mm. stroke. Trial trip Ausugt 22nd.

PERSONAL AND BUSINESS ANNOUNCEMENTS

HARDY, TOBIN AND CO., 110, Fenchurch Street, E.C.3, have relinquished the Agency for the Voith-Schneider Propeller in the United Kingdom. The sole agent now is Captain E. C. Goldsworthy, Stafford House, Norfolk Street, London, W.C.2.

LEHMANN, ARCHER AND LANE, Ltd., announce that on September 4th their offices and warehouse were transferred to a new building erected at their works. The company's sole address is now Hampshire Works, Fairlop, Barkingside, Essex.

THE BRITISH ALUMINIUM COMPANY, Ltd., is removing its head office from Adelaide House, King William Street, London, E.C.4, to new and larger quarters at Norfolk House, St. James's Square, London, S.W.1. This new head office, after September 18th, will be the registered address of the company.

CONTRACTS AND ORDERS

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

BENNIE LIFTS, Ltd., London, S.E.11, have received a contract for the installation of the lifts at St. George's House, New Oxford Street. The lifts will operate at 400ft. per minute on a variable-voltage system of control incorporating flying stop car switch and self-levelling. The car and landing doors will be operated by power and the cars will be fitted with interconnected communicating signalling indicators. In view of the high speed at which the lifts will operate, rope compensating gear is being included in the installation, together with hydraulic buffers.

CATALOGUES

CATERPILLAR TRACTOR COMPANY, Peoria, Ill., U.S.A.—Particulars of the diesel D 6 tractor.

LONDEX, Ltd., 207, Anerley Road, London, S.E.20.—Leaflets on electro-magnetic relays for A.C. and D.C.

FOXBORO-YOXALL, Ltd., Lombard Rd., Merton, S.W.19.—Particulars of the "Foxboro" air weight controller.

RANSOMES AND RAPIER, Ltd., Ipswich.—Particulars of portable self-contained, self-priming, 4-in. water pump.

TOM SENIOR, Atlas Works, Hightown Heights, Liversedge, Yorks.—1940 catalogue of castings and tools for engineers.

WESTINGHOUSE BRAKE AND SIGNAL COMPANY, Ltd., 82, York Road, N.1.—"The A B C of Westinghouse Relay Interlocking."

H. WIDDOP AND CO., Ltd., Greengate, Keighley.—An illustrated folder of marine oil engines ranging from 11 to 300 B.H.P.

MORRIS MOTORS, Ltd., Cowley, Oxford.—Catalogue containing specifications, prices, etc., of industrial petrol and paraffin engines.

VERSIL, Ltd., Rayner Mills, Liversedge, Yorks.—A book describing the composition, fabrication, and uses of glass silk insulation.

JOHN M. HENDERSON AND CO., Ltd., King's Works, Aberdeen.—List 83-I E on aerial cableways for dam and barrage construction.

WESTINGHOUSE BRAKE AND SIGNAL COMPANY, Ltd., 82, York Road, King's Cross, N.1.—Descriptive booklet of hump yard equipment.

TANGYES, Ltd., Cornwall Works, Birmingham.—"Modern Engineering," a small descriptive book of the company's wide range of products.

BRITISH INSULATED CABLES, Ltd., Prescot.—Publications M108 on radio materials and 109 on paper dielectric and electrolytic condensers.

GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, W.C.2.—Publication No. 8760 on electrical equipment for the aircraft industry.

DUBILIER CONDENSER COMPANY (1925), Ltd., Ducon Works, Victoria Road, North Acton, W.3.—Illustrated price list of condensers and resistances.

W. SISSON AND CO., Ltd., Elmbridge Rd., Gloucester.—"Fifty Years of Engineering," a brochure commemorating the jubilee year of the company.

NORTHERN ALUMINIUM COMPANY, Ltd., Bush House, Aldwych, W.C.2.—"The Applications of 'Noral' Aluminium Alloys to Shipbuilding and Marine Engineering."

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria Street, London, E.C.4.—Publications 1391, on industrial vacuum cleaning, and 1036, on propeller fans.

VERSIL, Ltd., Rayner Mills, Liversedge, Yorks.—A folder with a sample of "Versilent" glass silk acoustic insulation which can be applied direct to brickwork, cement, or concrete.

ALUMINIUM UNION, Ltd., The Adelphi, Strand, London, W.C.2.—A 120-page book on aluminium engineering section giving diagrams and details of the company's large selection of extruded sections.

AUTOMATIC COIL WINDER AND ELECTRICAL EQUIPMENT COMPANY, Ltd., Winder House, Douglas Street, London, S.W.1.—Leaflets on the "Avometer" electrical measuring instrument and the "Avo" test bridge.

UNITED STEEL COMPANIES, Ltd., 17, Westbourne Road, Sheffield, 10.—Publication W 220, giving full analyses and technical details of all grades of Workington and Distington irons, and of the "Uco" high-duty, cylinder, and malleable machine-cast irons.

COPPER DEVELOPMENT ASSOCIATION, Thames House, Millbank, S.W.1.—"Lead-Bronze Bearings," an English edition of the German publication issued by the Deutsches Kupfer-Institut. E.V., of Berlin.

ALFRED HERBERT, Ltd., Coventry.—Fifth edition of the booklet on "Ardoloy," the high-speed cutting alloy made by the British Thomson Houston Co., Ltd. It describes the material's composition and application to a wide range of tools.

RUSTON BUCYRUS, Ltd., Lincoln.—Catalogue of the 10-R.B. $\frac{3}{4}$-yard Universal excavator, the 1000th of which has just been delivered. These machines are made with equipment for operation as a shovel, dragline, drag shovel, skimmer, grabbing crane, crane, pile driver, or tamper.

HOLDEN AND BROOKE, Ltd., Sirius Works, Manchester, 12.—General catalogue No. 400 of the company's standard products, which include centrifugal pumps, feed-water heaters, calorifiers, oil coolers and heaters, steam traps, injectors, ejectors, and ejector heaters, steam dryers, turbines, &c.